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THE
Human Body.

64-Picture

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THE

HUMAN BODY

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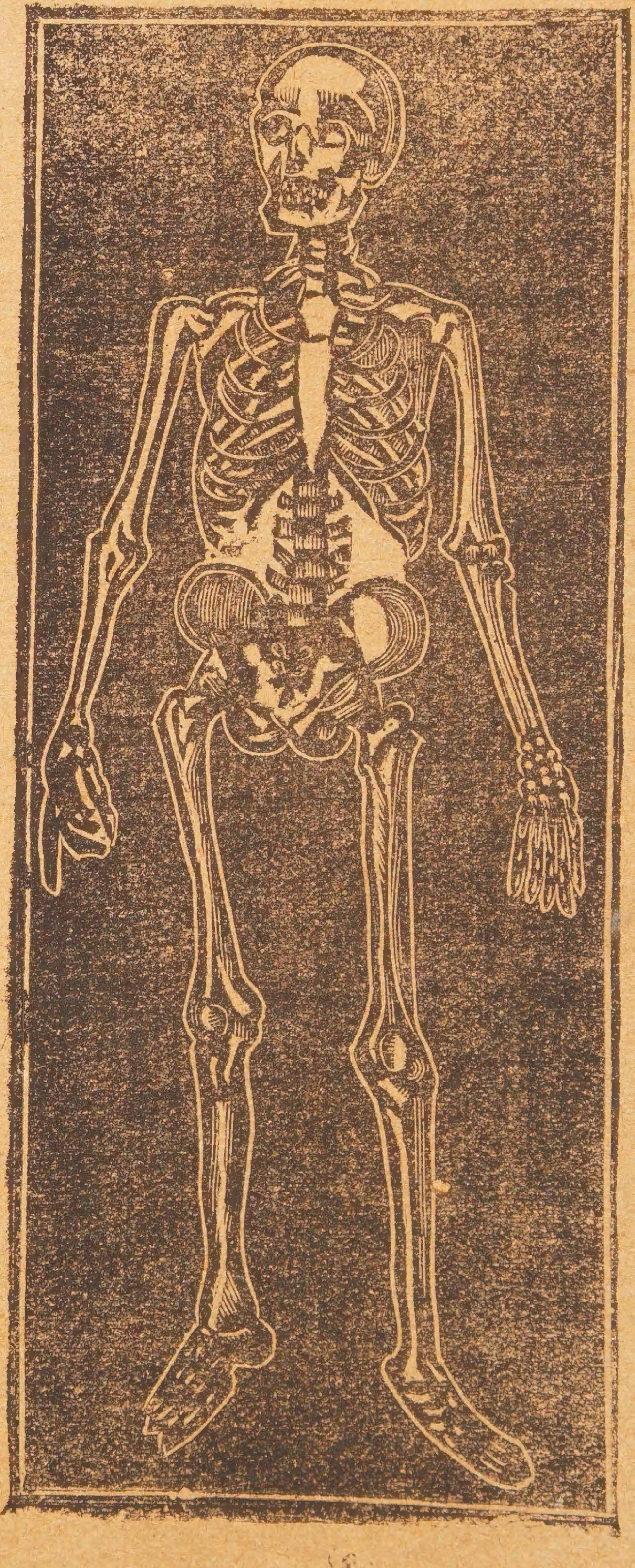
PREFACE.

It is a fact known to all that sages have averred that of all things created by God, *Man* occupies the highest rank. The division of the objects of the world will take in (*a*) the not-living and (*b*) the living things : the latter is liable to the sub-division (*c*) plants, (*d*) animals and (*e*) man, Those comprised in class (*a*) do not seem to be alive, The classes (*c*) and (*d*) prominently and fundmentally differ from each other the former are, with few exceptions, permanently attached to the soil and absorb nourishment in the liquid or gaseous state only, and their tissues are wholly built up from inorganic matter. The latter have the power of locomotion and of acquiring food and preserving themselves from enemies. The glory and distinction of *man* is that, with an increased sensitiveness to pain, he is continually and steadily advancing in the knowledge of the vastness and mystery of the universe in which he lives. Of such human beings it will be evident, as is uniformly mentioned in the sacred books of all religions, that those not affected with deformities occupy a more exalted rank.

In the accompanying pages it is endeavoured to make a critical study of the human body, the vehicle placed in his charge, as to its nature, the proper mode of regulating and controlling it without allowing its energies to be impaired, and if possible, to give permanence to and improve its energies. In fact, the mechanism of the human body is such that, consistent with the saying " Every one is the architect of his own fortune", he who takes the greatest care regarding its up-keep will secure the fruits thereof, to wit, physical strength, immunity from diseases, firmness of mind, full control of feelings and impulses, and naturally flowing from the above, disinterested benevolence, spirit of devotion and the knowledge of the duties to God and Man.



THE SECRET ECONOMY

OF THE

HUMAN BODY.

CHAPTER I.

THE human body is the entire physical part of man· The frame work of such body composing of bone and cartilege is known as the skeleton, It may be graphically divided into three parts—the head, the trunk, and the limbs. The head is set on the neck, which widens out into the trunk, in which the upper limbs (the arms) and the lower limbs (the legs) are set. We see only the outside of the body—the skin—which covers over as with a garment all the parts and mysterious workings that are without pause going on during our whole lives. Under the skin is the flesh or muscle, and under that a strong framework made of bone.

The skin or the sensitive organ of touch, is spread over the body in many layers. The outer layer or the protective covering of the skin is called the ***cuticle***, scarf skin or epidermis. It is insensible and thickest on the soles of the feet and on the palms of the hands. Lying underneath the above is the ***true*** skin or the ***derma***, the sentient structure, containing the papillæ, nerves and blood vessels. It is marked in various places by furrows, also affecting the cuticle, as may be seen in the skin of the hand. The papillæ are small, conical projections, besetting the whole surface of the skin, but largest and closest on the palm of the hand and fingers, and on the sole of the foot. Into these blood vessels enter, and also nerves ; and they are the medium of the tactile sensibility of the skin.

Two species of glands concern the skin as a purifying organ—the one yielding sweat, the other an oily secretion. Each of these glands is a coiled-up tube, and the ends of these thousands of tubes, which open on to the surface of the skin, are called pores. Through these tubes and pores, the skin is constantly giving of waste matter in the form of perspiration. [Note.—These are so constructed as not to allow water get into the body if the living body be immersed in that element for any length of time.] The waste matter consists of water, minerals, and other matter, including the worn-out cells in the skin which are always being given off. The skin, thus, acts as a kind of lung spread all over the body and it is important that it should be kept clean, lest the glands cannot get properly rid of the waste they receive from the blood. On an average, a healthy male adult loses daily in this way 18 ounces of water, about 300 grains of solid matter and about 400 grains of carbon dioxide. The solids consist chiefly of fatty acids and urea with various salts. Should perspiration be rapidly excreted or slowly evaporated, it becomes visible; but when it does not gather in drops, an invisible perspiration is slowly going on. The amount of sweat is largely influenced not only by conditions of temparature, but by various drugs and a close relation exists between the secretion of urine and that of sweat. If the pores of the skin are stopped up by an effective covering or coating, the person will become suffocated and death may result. Good warm baths are necessary for cleanliness, while cold baths in the morning brace up the body and keep it strong.

The *hair* contained in the epidermis is really part of the skin, of which it forms a kind of out-growth. Every hair grows from a kind of little bulb under the skin which consists of tiny cells. Owing to the formation of new cells in these bulbs, the old cells are forced outward, forming part of the hair which is thus caused to grow. The hair cells contain a special oily colouring substance: this substance is dark brown in dark-haired people, and of a yellowish tint in fair-haired people, and the color of the hair depends a great deal upon the amount of this colouring matter. When there is no colouring substance in the hair-cells, the hair is quite white. Sudden shock or grief acts upon the hair in such a way as to rob it of its coloring matter and the hairs are turned grey. Curly hair and straight hair are the result of a difference in the hair formation

The *dermis* or true skin is supplied with blood vessels, and over its whole surface are papillæ, some of which cover capillary loops, while others contain touch corpuscles

Of the skin glands, there are two varieties—(1) the sebaceous and (2) the sweat glands. The former secrete a fatty substance which helps to keep the skin smooth and soft.

The functions of the skin are manifold. It is a protective covering and the fat secreted in it forms a soft elastic pad which protects delicate parts from external pressure. The epidermis, the dermis and fat prevent undue radiation from the body. The epidermis exercises elastic pressure on the cutaneous capillaries and prevents excessive diffusion of fluid from the vessels. Its respiratory functions have already been referred to. It is also in some senses an organ for the sensation of touch, for that of pain and for that of heat and cold. Dry skin is a bad conductor of electricity.

THE COMPOSITION OF THE BODY.

The substance of the body is composed of oxygen, carbon, hydrogen, nitrogen, phosphorus sulphur, iron, magnesium, calcium, sodium, potassium, chlorine, fluorine &c.

Before dealing with the various parts of the body, it will be useful to know something about the *joints*, the *muscles* and the nerves.

A *joint* is formed by the approximation of two or more bones which are bound together and enveloped by other structures. They are either (*a*) *rigid* as in the cranial bones or (*b*) *mobile* as those between the vertebræ; or (*c*) *freely movable* as the knee and the maxillary joints, That in class (*c*) may be hinge shaped or (*d*) of the ball-and-socket form, as in the shoulder ; or, again, the movement may be either gliding or rotatory. In the mobile joint, the end of each bone is covered by a thin layer of cartilege which acts as a smooth bearing surface over which the other moves with little friction. Such a joint is also provided with fibrous ligaments, which by binding the bones together limit the range of movement, and with a sac, the inner surface of which secretes a lubricating fluid.

THE MUSCLES.

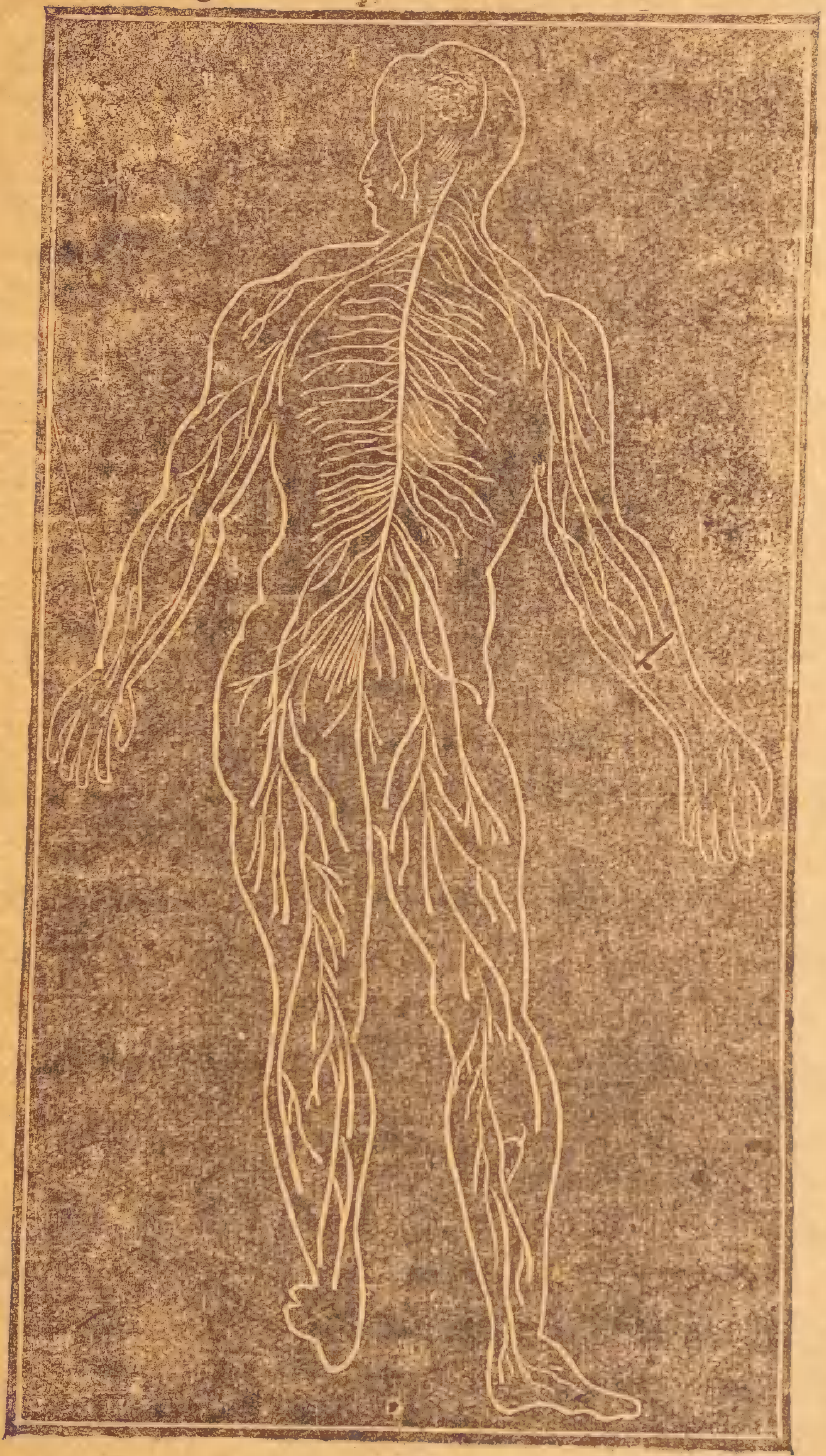
The muscles—the flesh of the body—are the organs of motion, and consist of small bundles of fibres joined to the bone at each end by little bands of gristle, called *tendons*. The muscles are classified into (*a*) voluntary or (*b*) involuntary. (*a*) The *voluntary* muscles are under the control of the will and their fibres exhibit a cylindrical form, with minute transverse stripes. The bundles of fibres are bound by connective tissue, which also forms a sheath for the whole muscle. Each fibre has a membraneous envelope which is blended with the tissues of the tendon. Within this investment lie the true muscular elements. (*b*) The *involuntary* muscles are found chiefly in the walls of the hollow viscera, such as the blood-vessels, the intestines and the bladder. Their fibres are spindle-shaped and non-striated. They are generally bound into flattened bundles by a cement substance and ordinary areolar tissue. One great involuntary muscle, the heart, is composed of striped muscular tissue differing in some respects from that of the voluntary muscles. All muscles are abundantly supplied with capillaries which run between, and with nerves which terminate in the fibres. The normal stimulus is nervous, but the muscles may also be made to contract by electrical stimulation, by a pinch, or by a blow. In the production of muscular work a considerable increase takes place in the amount of oxygen used by the body. As a result of prolonged and repeated use, both voluntary and involuntary muscles increase enormously in size through the formation of new fibres. Disuse, on the other hand, and loss of nerve supply lead to the diminution of the muscle substance. After death the muscles lose their elasticity and contractility passing into the state known as *rigor mortis* or rigidity.

The muscles (more than five hundred in number) are the means by which movements are carried out, by their shortening or lenghening themselves at will. The muscles are the servants of a number of fine white threads called nerves, which lie between them, and are connected with the brain. They cause movement by the wonderful power given to them of shortening or lengthening themselves at will. It has to be noted that the erect position of man is the result of the combined action of the muscles of the calf, the thigh, the back and the neck.

THE NERVES.

A nerve is a cord-like structure composed of delicate filaments by which sensations or stimulative impulses are transmitted to and from the brain or other organs. Each nerve is constituted of a collection of nerve bundles surrounded by a sheath of connective tissue, and the various bundles are bound together by bands of similar tissue. The individual fibres within each bundle are attached to one another by more delicate connective tissue. Each fibre presents a central thread called the axis cylinder, a fatty medullary sheath, and externally a primitive sheath. Of these three parts the first is associated with the transmission of nervous energy, the next is nutrient, while the last supports and strengthens the more delicate parts within. Each fibre connects a central nerve cell with a pripheral end organ. Some nerve filaments terminate in muscular end plates, through which the stimulus for contraction is communicated to the muscle. The leading characterestic of a nerve cell is its irritability; that of a nerve fibre is its faculty of transmitting waves of nerve energy at the rate of about a hundred feet per second, from the brain to the end organ.

The nerves are at the outset, divided into (1) ***cerebro-spinal*** and (2) ***sympathetic*** nerves; the former is again



The Journey of the sensation.

classified as *cranial* and *spinal*. The spinal are again subdivided into *cervial, dorsal, lumbar, sacral* and *coccygeal*, according to the portions of the spinal column with which they are connected.

According to the simplest classification, twelve pairs of cranial nerves spring from the brain and reach the nose, the eye, the face and the tongue, the ear, the mouth, the thorax and the abdomen. Of the spinal nerves thirty-one spring from each side of the cord. Each spinal nerve has motor and sensory roots, with a ganglion upon each root. The root roots coalesce, and many of the spinal nerves unite at some distance from the spinal cord to form a network.

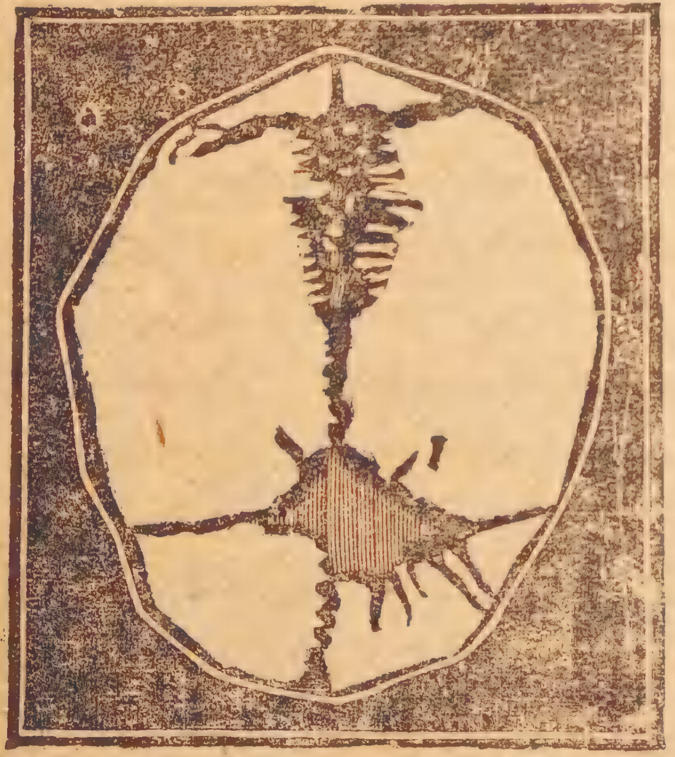
Those nerves which convey feelings to the brain are called the *sensory*, while those which convey the will of the brain to the muscles causing movement the motor, nerves. The nerves are also capable of various reflex actions, both occasional in response to casual excitements, and regular, as in sustaining the involuntary action of the heart, lungs and other organs.

The *sympathetic* nervous system or system of nerves forms a double chain of ganglia, one on each side, or slightly in front, of the spinal column. These ganglia communicate with each other and with the spinal nerves by delicate threads. Nerves arise from the ganglia, and are distributed chiefly along the blood-vessels. They also form considerable plexuses about the thoracic and abdominal viscera. Free intercommunication exists between the symathetic and cerebro-spinal systems, and many of the sympathetic fibres are ultimately derived from the cranial and spinal nerves and centres.

CHAPTER II.

THE SKULL.

The skull or cranium is the skelton or framework of the head of man. It is an expansion of the vertebral column at its utter or anterior extremity. It normally contains twenty two bones. Dividing the skull into two great divisions, the cranium and the face, the former is made of eight bones, and the latter of the remaining fourteen. The bones unite in several cases by sutures, the edges being irregular or toothed. Two spots in the vault of the skull are uncovered by bone at birth. These are called the anterior and posterior fontanells, or little fountains, since there the



THE SKULL IN THE INFANT.

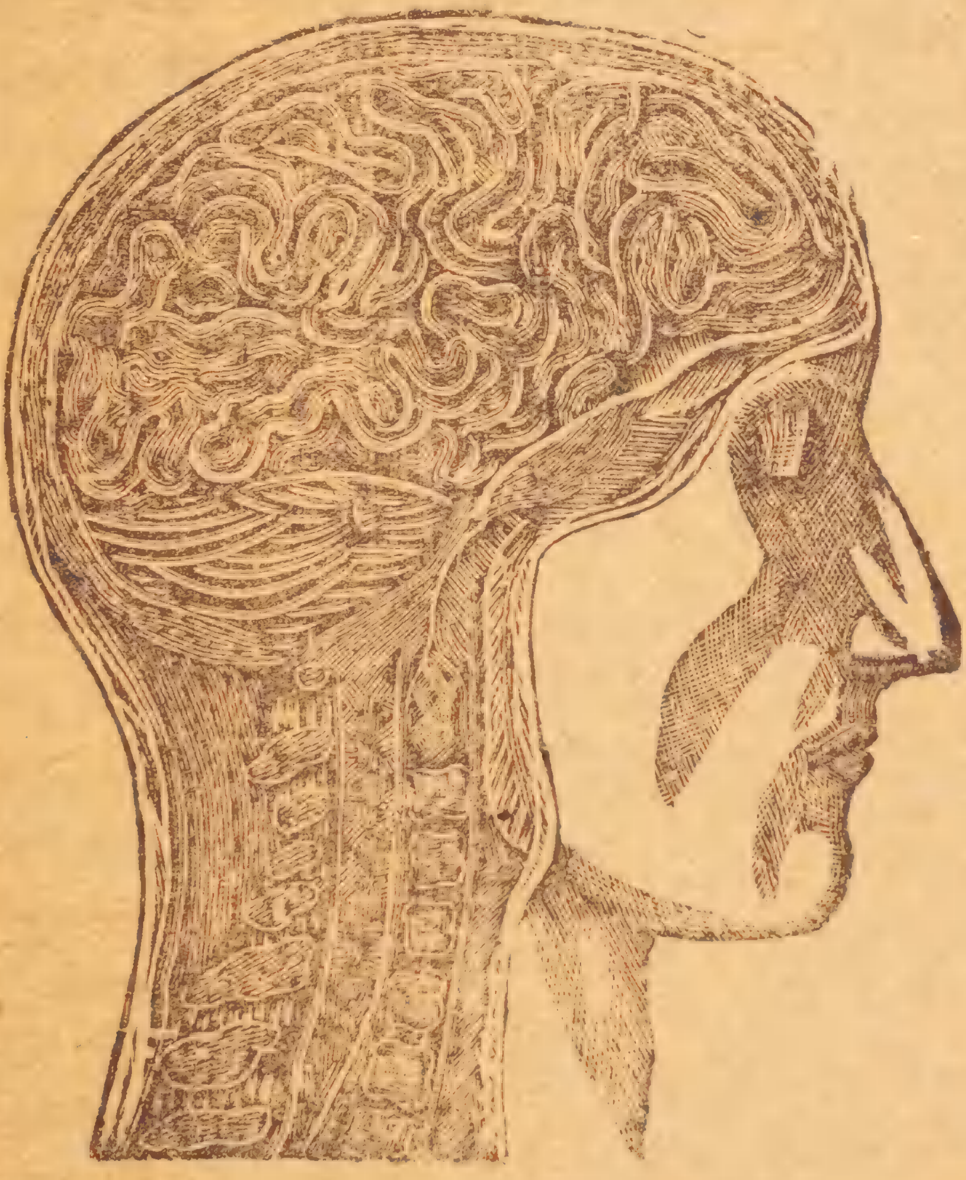
pulsations of the blood may be felt or even seen. The anterior is the larger, and is not covered by bone for the first year or two. The posterior becomes assified in a few months after birth. In addition, the sutures are open at birth, and remain open for a varying number of years. The cranium, formed by the upper and back part of the skull, contains the brain, which *is* connected with the spinal cord through an opening in the base of the occipital bone. The bones of the skull are pierced in various places for the issue of cranial nerves, strarting from the brain and for the passage of blood-vessels. The skull may greatly vary in size, within certain limits, without any apparent effect upon the brain contained.

THE HEAD,

It is that part of the body of man that contains the *brain*, and the organs of special sense—the ear, the eye, the nose, the mouth and the tongue.

The Brain is that part of the central nervous system that is within the skull brain-box, or cranium, the bony a framework of the head. As the seat of the mind, it is the most important part of the nervous system. It is protected by the skull, between which and the brain are delicate serons membranes and a small quantity of fluid(the cerebro-spinal fluid) which acts as a water-bed, lessening the shock of any blow.

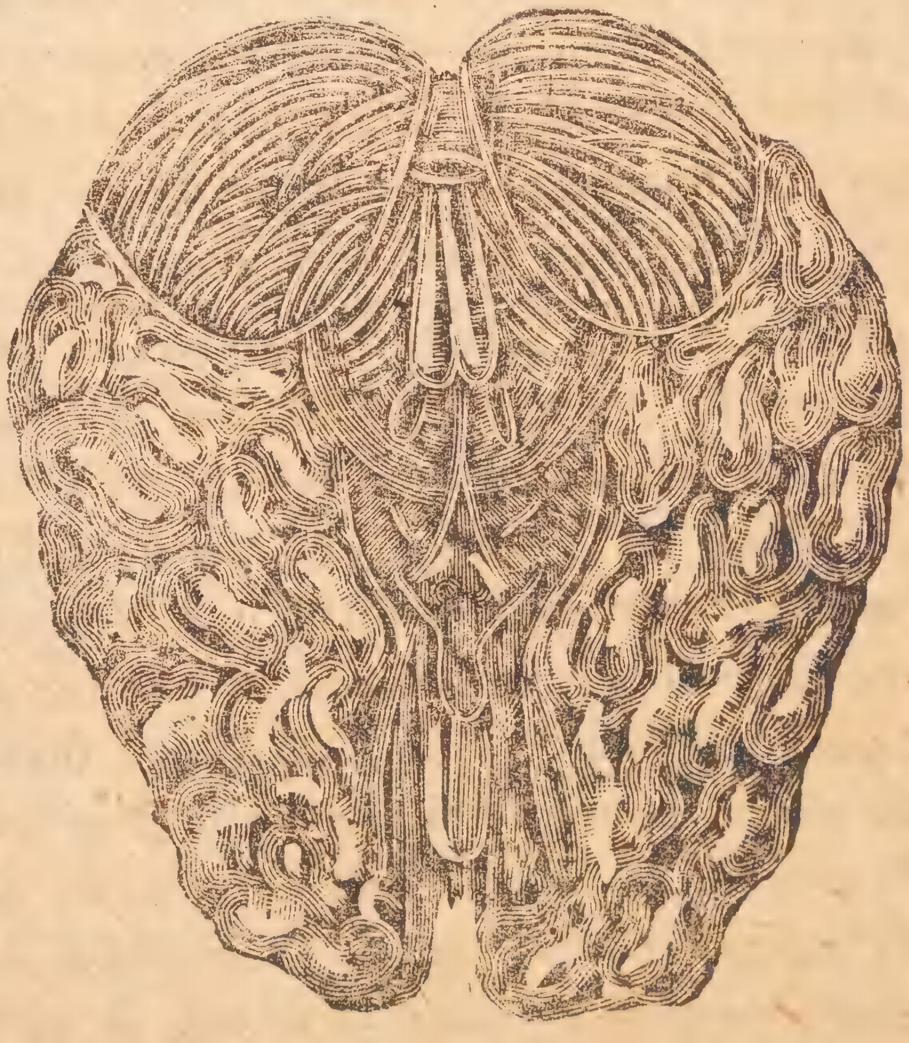
The brain is divided into four principal parts—the *cerebrum* or brain proper, the *cerbellum* or little brain, *pons*varrolii, and *medulla oblongata*. The *cerebrum* (the upper part) or fore-brain forms the largest part of the brain and contains what are commonly spoken of as the 'higher centres' is divided longitudinally into two cerebral hemispheres, the right and left by a fissure or mass of white tissue. The surface of each cerebral hemisphere is again arbitrarily divided into four lobes. Broadly speaking, the cerebrum is made up of gray matter and white matter. The surface of the cerebrum, in fact of the whole brain, is covered with gray matter, *i. e.*, brain-cells or centres, and owing to the arrangement of the surface in convolutions, the gray matter dips into the fissures, and so covers a large area than it would were the brain uniformly smooth. This grey covering is the true brain, and is made up of a number of nerve-cells from which a number of nerves branch out. In this gray part of the brain are the centres of seeing, hearing, smelling, speaking, touching, and above all of thought. Islands of gray matter are also embedded



in the white. The weight of the brain seems to give a general index of brain power which is believed to depend mainly on the amount of convolution found more marked on some brain surfaces than on others. The whole brain is supplied with blood from the two internal carotid arteries and two vertebral arteries. There is also a circulation of lymph ; each cell of gray matter lies bathed in lymph. The centres for movement of one side of the body lie on the opposite side of the brain. Thus, the left hand is guided by the right cerebral hemisphere.

THE CEREBELLUM.

The cerebellum or little brain lies under the after part of the cerebellum, and is connected with that and other parts of the brain by processes called *crura* (legs). Two such join it to the cerebrum, two to the medulla oblongata



and two more form the ponsvarolii. The cerebellum is divided into lateral hemispheres, with six lobes lying between. It is formed, like the cerebrum, of gray matter overlying white, with distinct masses of gray also in the interior. Diseases of certain parts (lobes) of the cerebellum is believed to affect equilibration (balancing) and co-ordinated (controlled) movements. Some of the nerve fibres (white matter) are believed to be concerned in muscular sense, but the function of the greater part of the cerebellum is unknown.

Ponsvarolii. It is made up mostly of bundles of nerve fibres joining the higher parts of the brain with the medulla. The cerebellum lies above it, the cerebellum behind it, and the medulla oblongata below. It is the protuberance containing the commissural fibres that at the base of the brain connect the two hemispheres of the cerebellum, and bridging over the structures extending upward from the medulla oblongata. It derived the name from constanzo varolis, an anatomist of Bologna.

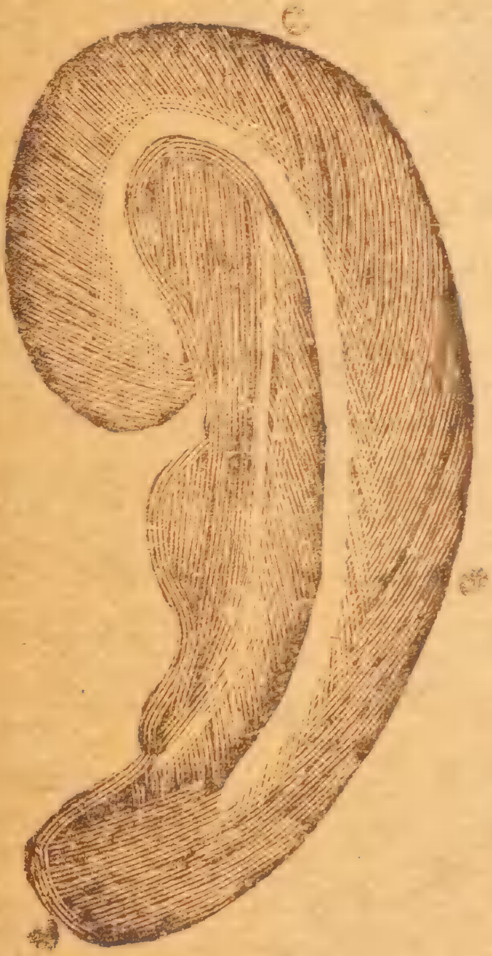
The *Medulla oblongata* or the spinal bulb is the expanded upper end of the spinal cord. It is rather a combination of the spinal cord with the cranium. Of its nerve fibres, some run through the ponsvarolii into the cerebrum, while others run directly into the cerebellum. It must be noted that all connections of the brain with the spinal cord pass through the medulla. In it there is also gray matter, which forms various collections of cells known as the vital centres. These work independantly of the will, and govern respiration, the heart's action, the constriction of blood vessels swallowing and secretion of salina. The last six of the twelve pairs of cranial nerves (*vide* page 8 *ante*) arise from the medulla. When the medulla is cut all sensation is lost, because all impulse fails to reach the cerebrum. All voluntary movement is abolished, because the cerebrum cannot send down a message Death immediately follows, because of interference with the impulses by which heart and lungs are kept in action. It is in the medulla that most of the nerve fibres cross; so that fibres which started on the right side of the brain reach the left side of the spinal cord, and those starting on the left go to the right.

The brain is remarkable as an organ both for its extreme delicacy and its great power of resistance and recuperation. A man live with a bullet in or through his brain, and may die as the result of brain trouble the originating cause of which cannot be detected by any known method; he may live after an iron bar has passed through the root of his mouth and out at the crown of his head, yet he may die because of a minute clot of blood.

The base of the brain, resting on the base of the skull, the floor of the cavity which holds the brain gives off cranial nerves in twelve pairs, each cranial nerve arising from a spot on one half of the brain corresponding to that from which its fellow arises on the other half, and each being traceable to a similar centre; the centre or directing cells of gray matter, being also in pairs, *i.e.*, in corresponding positions in the cerebrum or cerebellum on either side of a longitudinal mesial live. Certain special centres (not for cranial nerves) are apparently single. Such is the speach centre, low down on the gray matter in front of the left cerebral hemisphere. Any brain centre may conceivably be trained by use, enfeebled by disuse or insufficient use, excited by irritants, and paralysed by a sufficient injury. A nerve centre also becomes irritated by a certain degree of pressure, and works independently of volition.

The brain at birth is heavy in proportion to the total weight of the body. It increases rapidly during the first seven years; move slowly from them until the age of about twenty; then more slowly still, until about forty. Soon after that age the weight begins to lessen very slowly. Sight and hearing are dormant at birth, and all the other senses are probably almost functionless. "A man is as old as his tissues," and their age for working purposes is governed by the treatment which he has given them.

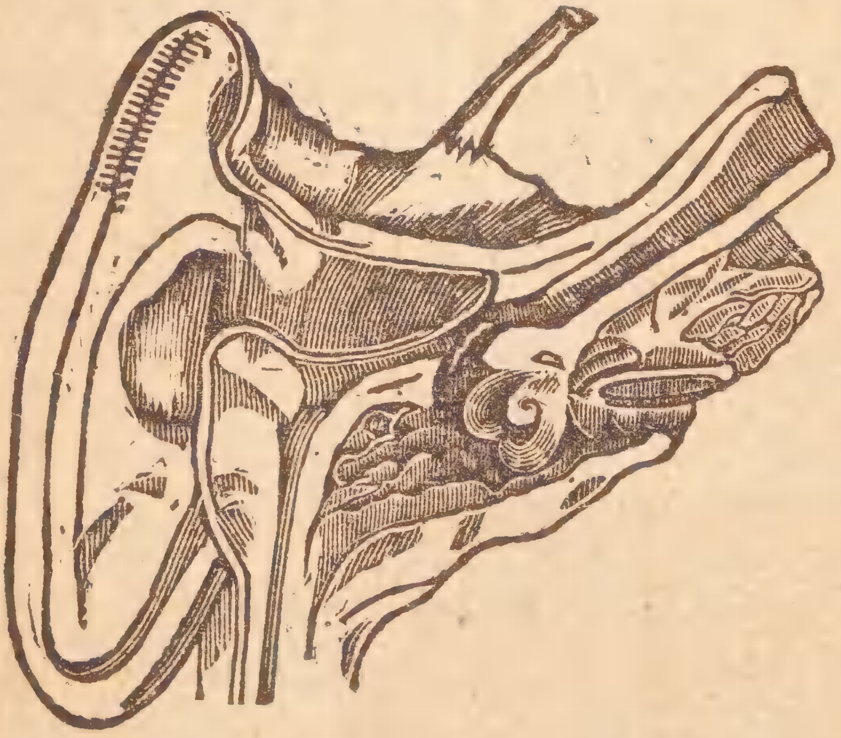
THE EAR.



This is the organ of hearing. It consists of three parts—(1) an external ear or auricle for collecting sounds, (2) a middle ear or tympanum for transmitting them and (3) an internal ear or labyrinth for delivering them to the end-organs of the auditory nerve.

The *external ear* consists of the auricle or pinna, popularly known as the pinna, and the auditory canal, which ends internally at the drum or *membrana tympani*, a stretched membrane on which the sound waves beat. It angments the sound by reflexion and includes the wing of the ear.

The *middle ear* or *tympanum* is a narrow, irregular cavity holding air and three small bones, the mallens (hammer), incus (anvil) and stapes (stirrup), which form the last link in the bone-chain between the outer and the inner ear. This part communicates with the throat through the Eustachian tube, which is a membraneous canal, of very small diameter, opening into the middle ear at one end, and into the back of the throat at the other and allowing air reach the tympanum, so that the atmospheric pressure is kept equal on both sides of the drum. The inner wall of the tympanum, which is the outer wall of the labyrinth, is an even surface of bone, but chiefly noted for two openings—the oval and the round—both closed with membrane. It is to the oval opening that the inner end of the chain of bones, the stirrup bone, is applied. Of the muscles, the largest is attached to the outer bone of the chain (the mallens), and is called *tenson tympani*, because its action is to draw inwards, and tighten, the tympanum.



The *internal ear*, or *labyrinth* from its complicated formation, contained in the petrons or hard portion of the temporal bones, is made up of two structures, the bony and the membranous labyrinth. The bony labyrinth presents externally a spiral shall called the cochlea, and three projecting rings called the semi-circular canals, very much convoluted. The interior is hollow, and filled with a clear, serons liquid secreted from a thin lining membrane. It contains a membraneous structure, corresponding in shape to the tortuosities of the bony labyrinth, this structure encloses a liquid secretion, and supports the ranifications of the auditory nerve. This part communicates with the middle ear through the fenestra ovalis (oval window), which receives a point of the last bone (stapes or stirrup) of the chain in the middle ear. It holds the end-fibres of the auditory nerve, through which sensations of sound are carried to the brain. The different canals communicate with each other.

Sound-waves are carried by the auditory canal against the tympanic membrane. This vibrates, and its vibrations are communicated to the chain of bones in the middle ear, through which sensations are conveyed to the auditory nerve in the internal ear, and thence to the auditory centre in the brain. The first two parts are appendages or accessories of the third, which contains the sentient surface

This sense-organ subserves two distinct functions: it enables the organism to perceive vibrations and to maintain equilibrium. The combined action of the two ears materially aids the perception,

THE EYE.

The eye is the organ of sight. The eyes are very delicate organs and we should always be careful not to do anything which would tend to strain or injure them in any way. The eyes rest in the two hollow orbits in front of the skull. The structral details of the organ consist of (1) the eye-brows, (2) the eye-lids, (3) the eye-ball, (4) the three coats or tunics, and (5) the three transparent refracting media enclosed by them.

(1) THE EYE-BROWS.

These are thick arched hairy ridges, surmounting the orbit, and acted on by muscles, so as to constitute part of the expression of the face.

(2) THE EYE-LIDS.

Each eye has two eye-lids. There are two thin moveable folds that screen the eye; the upper is the larger and more moveable, having a muscle for the purpose. The length of the opening various in different persons, and gives the appearance of a larger or small eye. The lids are close to the ball at the outer angle; and near this body, the lachrymal ducts pierce both eye-lids. These have their under or inner surface lined with conjunctival membrane. The lachrymal apparatus consists of (*a*) the gland for secreting the tears at the upper corner of the outer side of the orbit; (*b*) the two canals for receiving the fluid in the inner side of the orbit, and (*c*) the sac, with the duct continued from it, through which the tears pass to the nose. The tears are secreted by the lachrymal gland lying at the outer angle of each eye and poured out from the eye-lids upon the eye-ball; the washings afterwards running into the lachrymal sac, and thence away by the nose. When the tears pass on to the surface of the eye through the lachrymal ducts, the action of the eye-lids keeps them constantly flowing towards the inner angle at the nose, carrying with them anything, such as dust, which has fallen on the eye. At the side of the nose the tears enter two little canals which, join at the lachrymal sac, and the canal then runs directly downward, becoming the nasal duct, through which tears are always flowing into the interior of the nose. The edges of the lids show the eye-lashes, which serve as screens, preventing large quantities of dust from entering the eyes, even when the lids are a part. Under the edges of the lids are rows of peculiar glands secreting a material which prevents the lids from adhering to each other. The movements of the lids is largely reflex. The eye-lids help to protect the eye from exposure to light, dust, &c, The eye-lashes also serve to keep out dust and dirt.

(3) THE EYE-BALL.

It is placed in the forepart of the cavity of the orbit. It is fixed there by the optic nerve behind, and by the muscles with the eye-lids in front, but with freedom to change its position. The form of the ball is round but irregular. It is made up of to segments from a larger and smaller sphere. The smaller segment is to the front, and consists of *cornea*, covered by mucous membrane (conjunctiva), aqueous humour, and *iris*. The larger segment lying behind the smaller, consists (from without inwards) of *sclerotic choroid* and *retina*—three layers or coats of different thickness, structure and function.

(4) THE THREE COATS.

The *sclerotic* is the outer investing membrane. It is a strong, opaque, unyielding fibrous structure and on it depends the shape and firminess of the ball. It extends over the whole of the larger sphere to the junction of the smaller in front. Its continuation or substitute in the clear bulging part of the eye is the *cornea*, equally firm elastic and tough but transparent, and practically a continuation of the sclerotic forward. This coat is about four-fifths of the shell ; the cornea, one-fifth.

The *choroid*, the next, is a membrane of a black or deep brown color, being the chamber of the eye up to the union of the sclerotic and cornea. It is composed of various layers. Outside are too layers of capillary blood vessels, veins and artaries. Inside is the layer containing the black pigment, which it is the object of the numerous blood-vessels to supply. The pigment is enclosed in cells of extremely ominute diametre and closely packed together. This coat and sclerotic are loosely attached to each other. The *iris* is the continuation forward of the choroid and attached all round at the junction of the sclerotic and cornea. It is the round curtain in front of the eye, with a central hole, the pupil, for the admission of light. Its anterior surface is colored and marked by lines, indicating or fibrous structure. The fibres are muscular being both circular and radiating. The *crystalline lens*, lying in the pupil behind the iris, is attached to the choroid by a circular ligament, the suspensory ligament. The lens is transparent, convex before and behind, the convexity tending to decrease with age as elasticity is lost. Accommodation of the eye to objects at short or long distances is produced by altering rhe convexity of the lens, through the ciliary muscles, which make taut or loose the suspensory ligament. While the iris, when contracting to lessen the pupil, acts as a curtain to cup off rays of light from the outer edge of the lens, the lense itself, because of its double convexity, brings to a focus on the retina those rays which pass through it.

The retina, or the nervous coat, lies upon the choroid but does not extend so far forward. It is the part of the eye which, one may say, all other parts combine to help. Whithout it there is no sight. Rays of light do not produce the image of an object until they fall upon the retina. It receives the impression and transmits it to the brain through the optic nerve. It is a very thin, yellowish, gary membrane. Relatively the most essential parts of retina are the rods and cones. At the centre is the yellow spot, which seems to have an acuter vision than any other part of the retina. If we wish to see an object clearly, we must look straight at it, so that the rays of light from it may fall upon the yellow spot The retina consists of not less than five layers—(*a*) the lining membrane, transparent, at the fore part, in contact with the back lens of the eye (*b*) the ranifications of the optic nerve, fine meshes of nerve fibre, exceedingly minute ; (c) nerve cells, resembling the cells of the gray matter of the brain, (*d*) a granular layer, with exceedingly minute filaments perpendicular to the retina, (*e*) the bacillan layer, made up of closely packed and very minute perpendicular rods, transparent and colorless. Interspersed with these are larger rods called cones, and by these larger and smaller rods the junction of the retina with the choroid is effected. Six or eight of the cones and a large number of the smaller rods grouped round them, enter each pigment cell. The rods are themselves in connection with the nerve fibers and nerve cells of the retina, through the five perpendicular filaments. All the elements of the retina are most abundant and close in the yellow spot or its vicinity, where vision is most distinct.

The size of the pupil depends on the degree of contraction of the iris. It is the color of the iris which makes the eye blue, or gray, or brown. If the pupil or central opening is large then the eye has a darker appearances. The light passes through both conjuctiva and cornea, then through the aqueous humour, lying in the papillary space, next through the crystatalline lens, behind that space, and finally through the vitreous humour, to fall on the sensitive lining of the eye, the retina. At the back of the eye, connecting it with the brain, is *the optic nerve,* which pierces the sclerotic, choroid and retina, and appears on the front of the last named, not quite in the centre, as the ‘blind spot.’ The optic nerve then branches out all over the dark inner surface or front of the retina making it sensitive to light. The delicate mucous membrane (conjunctiva) is so sentive that it acts as sentinel to the eye, giving warning of the slightest irritation to the surface. It is always moistand shining, from the fears which constantly cross from the lachrymal gland to the lachrymal sac.

(5) THE THREE MEDIA.

These are the humours or lenses of the eye. The *aqueous* humour in front, is a clear (thin) watery liquid lying (in front of the lens) under the cornea and bounded by the next humour, the crystalline lens and its attachments to the ciliary process. The *vitreous* humour behind (between the back of the lens and the retina) occupies the whole posterior chamber of the eye, about two-thirds of the whole. It is a clear thin fluid enclosed in membrane, which radiates into the interior like the partions of an orange, without reaching the central line where the rays of light traverse the eye. In shape, it has the convexity of the eye behind ; while there is a deep cup-shaped depression for receiving the crystalline lens in front.

The eye is moved by six muscles, four *recti* or straight and two called *oblique*. The former arise from the bony socket in which the eye is placed, around the opening where the optic nerve enters from the brain ; and are all inserted in the anterior external surface of the eye-ball, their attachments being respectively on the upper, under, outer and inner edges of the sclerotic. The superior oblique muscle arises close by the origin of the superior straight muscle, and passes forward to a loop of cartilege ; its tendon passes through the loop, is reflected back, and inserted on the upper posterior surface of the eye-ball. The interior oblique muscle arises from the internal inferior angle of the forepart of the orbit, and is inserted into the external inferior surface of the eyeball, behind the middle of the ball. The external rectus turns the eye outwards ; the internal, inwards ; the superior, upwards ; and the inferior, downwards. The oblique muscles turn the eye is oblique directions. The various muscles are co-ordinated to act in concert. When these are all in order, single vision is obtained one object only being seen. The sweep of the eye in all directions arises from the movements of the above muscles singly, or in combination.

The mode of action of the eye involves an optical effect. When the eye is directed to any object, the rays of light, entering the pupil, are so repracted by the combined operation of the homours, as to form an inverted image on the back of the eye, where the transparent retina adjoins the choroid coat. The pigment cells of the choroid of the choroid play an important part, being themselves acted on by the light.

DISEASES OF THE EYE.

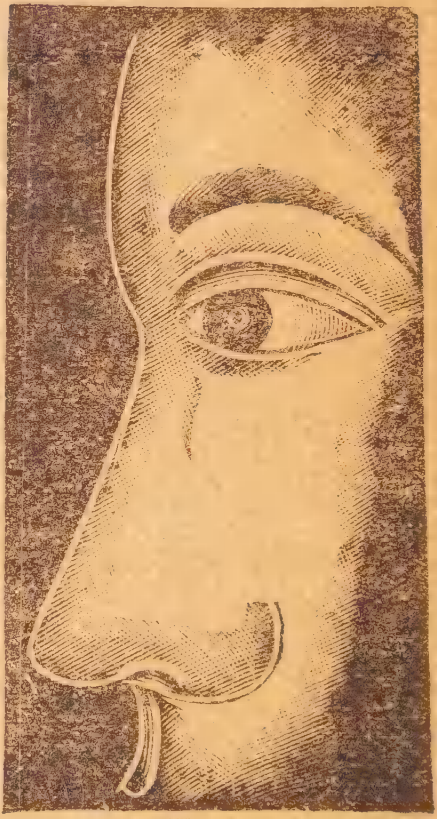
The conjunctiva lining the inner surface of the lids is often the seat of inflammation (conjuctivitis) to the treated by local a stringents and sometimes by constitutional treatment. A common trouble is a stye—a small abcess, about the root of an eyelash. An irritable condition of the nerve to the lid often causes constant nervous twitching. Paralysis of the special muscle to the upper lid causes perpetual droop, while paralysis of the muscle surrounding the eye prevents it from closing. The lids may, by affections of the muscles, the skin, or the conjunctiva be either everted or inverted. Sometimes, by stricture, conceretion, or inflammation, the apparatus for draining away the constantly flowing tears becomes blocked and watery eye results.

Defects of vision may ensue by diseases of the refracting media, *i. e.*, from injury to the cornea, inflammation of the conjunctiva and cornea, disease of the lens, and inflammation in the aqueous humour. Those which arise from disorder of the interior of the eye, of the optic nerve which conveys the stimuli to the brain, and of the special centres in the brain concerned in sight are of a more serious and often of a permanent character. The retina and its adjacent covering, the choroid, are subject to inflammation and degeneration, especially in adult and later life. Those due to central causes arise from the presence of a humour, or abcess, or haemorrhage in the sight centres of the brain, which are located in the posterior part of the brain. Some are also due to weakness or paralysis of the external ocular muscles of which a familiar example is seen in squint. The retina and aptic nerves are in some subjects particularly susceptible to the action of poisons, and more especially nicotine, blindness from tobacco being frequently met with. The removal of the cause is almost invariably followed by complete restoration of normal vision, although many months may elapse before the sight is fully restored. The use of spectacles for short sight or long distance does not in my manner affect the disease in the eye.

It is a striking peculiarity with the sense of sight, that the two eyes, instead of presenting two perfectly distinct pictures of the same thing, conspire the render the single picture more complete. This is termed *Binocular vision.* The picture of the object looked at is received by one eye, while the other merely extends its compass, and gives the dissimilarity of aspect that is a sign of the distance. It is a mistake to suppose that each eye sees a full and entire picture. Supposing the right eye to be the leader, if that eye is shut, the picture will be observed to shift its ground to the right ; in fact, an entirely new picture is formed by the left alone—a picture that is never allowed to be formed when both eyes are open. Again, in vision, the mind supplies far more than the sense receives. What the mind conceives is, not the optical effect actually presented at the moment, but a compound or accumulated effect, the result of all our past experience of vision in connection with the various movements that enable us to estimate real size and distance. The couvergence of the two eyes for near distances and their parallelism for great distances should also be noted. The above described three senses—Touch, Hearing and Sight may be called the intellectual senses by pre-eminence, while those of smell and Taste may be termed those of Organic life.

THE NOSE.

The nose, the tongue and the interior of the mouth form a portion of the sensitive organ (touch). The nose is the organ of smell placed at the entrance of the lungs. This sense is in close proximity to the organ of Taste with which it frequently co-operates. It is the chief channel of respiration in healthy people. The passages of the nose run upwards and backwards from the nostrils, and open above and behind the soft palate into the top of the pharynx. The passages of the nose are connected with the ears, behind the drum, by the Eustachian tubes, and with the eyes by the nasal ducts. Hence the inflammatory condition of the nasal mucous membrane, present in a cold, often spreads along the Eustachian tubes and causes temporary deafness. Air which is inspired through the nose is not only to some extent filtered of dust ; it is also thoroughly warned, no matter how cold it



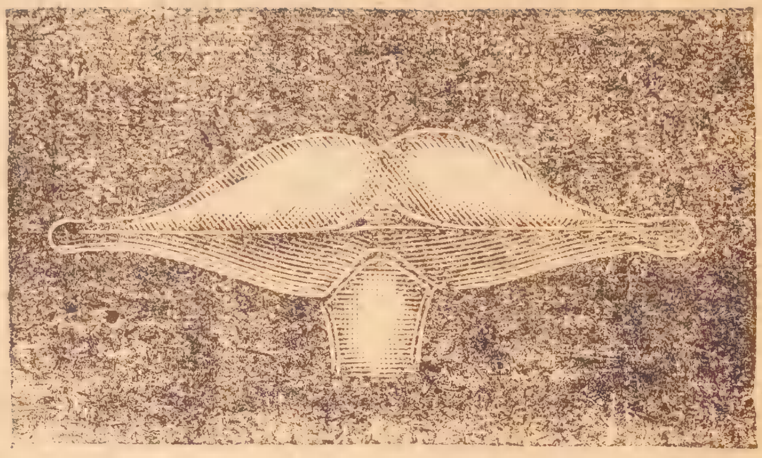
may previously have been, before it reaches the larynx. It is also moistered. In young children the constant effort to draw sufficient air through narrowed passages often produces a permanent deformity of the chest, known commonly as 'pigeon-breast.'

The nose is lined throughout with mucous mumbrane, and the complicated bones adjoining it give extension of surface to that membrane. The proper nerve of smell, called Olfactory, is most copiously distributed in the interior recesses, and not at all near the entrance of the nostrils, to which part, twigs of the fifth pair, are distributed, conferring upon it a tactile sensibility. The power of discrimination exercised by smell is very great. We derive much instruction and guidance by means of it. In the act of respiration accompanying mastication, especially the instant after swallowing, the odorous particles are carried into the cavities of the nose, and affect the sense of smell.

THE MOUTH.

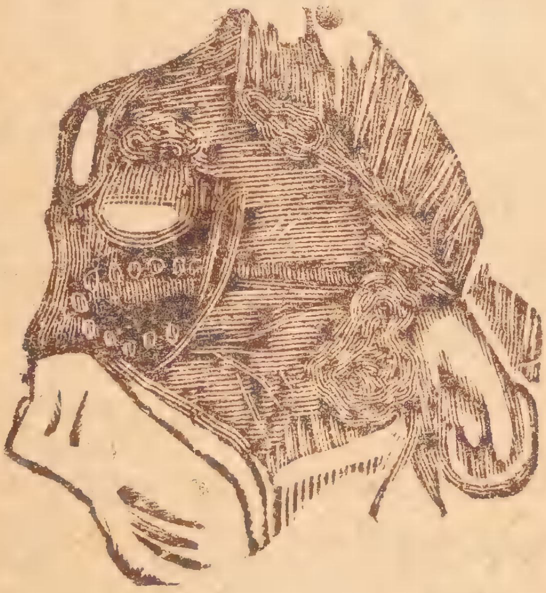
The mouth, the organ of speech, is the orifice at which food is taken into the body. It is the opening between the lips at the lower part of the face and is the entrance to the alimentary canal. The important organs of the mouth cavity are the teeth, the tongue, and the larynx.

The tooth is a hard, dense structure of epidermal origin, situated in or about the mouth and used for seizing and chewing food. In man, there are thirty-two teeth formed between 6 and 14 years of age—2 incisors, 1 canine, 2 pre-molars and 3 molars in each half of each jaw. These are preceded in the milk-dentition by 2 incisors, 1 canine and 2 milk-molars in each half of each jaw, or 20 in all.



The numerals denote the order in which the teeth appear in milk-dentition, and the period during which they do so in a child is from seven months to thirty months.

The lips are the two muscular organs that bound the mouth in front and cover the teeth.

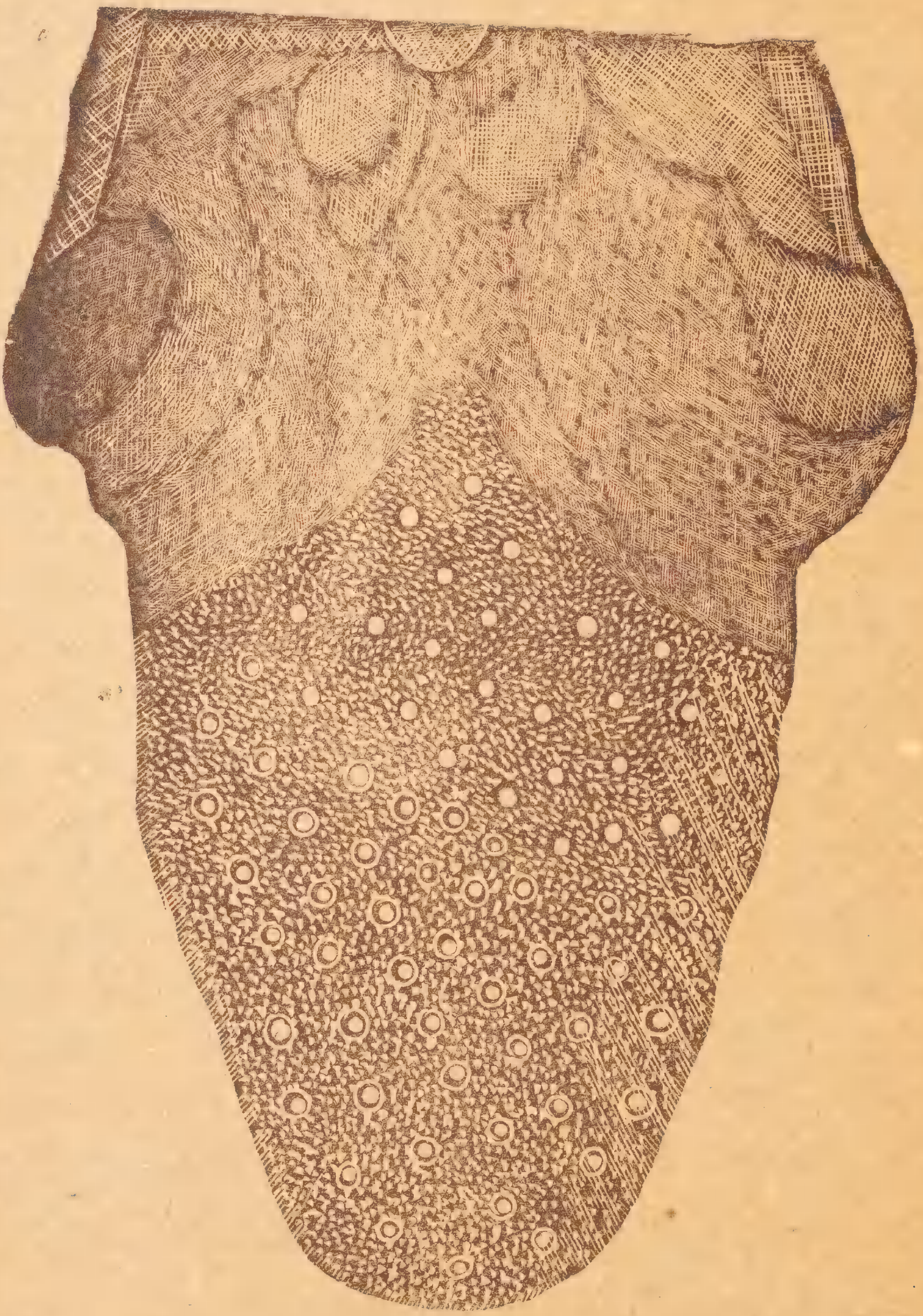


The salinary glands opening into the mouth secrete *salina* which moistens and softens all food chewed, and thereby prepares it for the action of the gastric juice when it reaches the stomach In addition, by virtue of ptyalin which it contains, it changes starch into sugar. It is derived from the blood by the secreting cells of the different glands. Smell, taste, the presence of anything in the mouth, or the mere motion of chewing will start the flow. The thought or the sight of food may 'make the mouth water'; and a copious flow of salina may precede vomiting. Some emotions, however, such as object fear, practically stop the flow altogether, with the result that 'the tongue cleaves to the root of the mouth', the lips become dry, and the voice alters because of the dryness of the tongue and the vocal cords. Salivation occurs during teething and pregnancy. In many cases it may be checked by the use of potassium chlorate, twenty grains to the ounce, as a mouth-wash.

The *palate* is the roof of the mouth, divided into the hard palate in front and the soft palate behind. The hard palate arches over to meet the gums in front and on either side, and is formed of periosteum, covered by mucous membrane. The back part of the soft palate hangs free, curving downwards and backwards. The velum (veil) is another name for it. The middle point of its posterior margin hangs down as the uvula, which is a small conical prolongation depending from the middle of the lower portion of the soft palate. Teeth arise from papillæ of the mouth epithelium. Externally there is a layer of enamel, which arises from the outer layer of the embryo, and is an exceedingly hard substance, containing but little organic matter. Beneath the enamel lies the dentine or ivory of the tooth, which arises from the middle layer of the embryo, and is not so hard as the enamel. Dentine is a substance analogous to bone, and is penetrated throughout by a series of canals, which open into the central cavity of the tooth—the pulp cavity. Within the pulp cavity lies the pulp, consisting of fine blood-vessels and nerve-fibrils. In some teeth the pulp cavity is widely open below, while in other cases, the fully formed tooth becomes narrowed below, so that the pulp is constricted; the narrowed region being the root or fang, which penetrates into the gum.

There is also a third layer frequently displayed known as cement. This when present, is the most external layer of the tooth, and is confined to the basal region. The other type of tooth is rootless.

THE TONGUE.



The tongue is the special organ of taste, and the seat of sensibility is its upper surface. The tongue is in fact the stomach begun. It is an important factor in the process of mastication and in the production of speech.

Mucous membrane invests its entire free surface; it is composed, like the skin, of a cutis or corium which supports numerous papillæ (little projections) to which its roughness is due. These are of three kinds, distinguished by size and form. The smallest and most numerous are conical or tapering, and cover the greatest part of the tongue, disappearing towards the base. The middle-sized are little rounded eminences scattered over the middle and fore-part of the tongue, being most numerous towards the point. The large-sized are eight to fifteen in number, situated on the back of the tongue, and arranged in two rows at an angle like the letter V. A mesial fibrous septum divides the tongue into symmetrical halves. The above papillæ contain capillary blood-vessels and filaments of nerve. The muscular fibres run in three directions—transversely, longitudinally and vertically.

Two different nerves supply the tongue: (1) branches of the tongue and throat nerve are distributed to the back part; and (2) twigs of the fifth pair of the cranial nerves go to the fore part. The effect is a two fold sensibility—taste proper attaching to the first named nerve. Bitter is tasted chiefly at the back part of the tongue. Taken as a whole, its sensibility is distributed over the whole upper side, but less in the middle part, and most in the base, sides and tip. The relish of food increases from the tip to the back, which is uninducement to keep the morsel moving backwards till it is finally swallowed.

THE LARYNX.

The larynx or the voice-box lies in the upper and front part of the neck, between the base of the tongue and the upper end of the trachea or wind-pipe. It consists of a tubular framework of nine cartileges, connected with each other by joints, membranes, ligaments and muscles. The largest of these cartileges is the thyroid, which is shield-shaped, and consists of two lateral wings diverging from a vertical central ridge in front. The upper part of the ridge forms the Adam's apple of the throat, and is more prominent in men than in women, because of the greater size of the thyroid cartilege in the male sex. Above and in front of the thyroid cartilege is a thin, leaflike structure, the epiglottis, which during ordinary respiration stands erect at the back of the tongue, but during the act of swallowing is pushed backwards and downwards so as to bridge over the upper opening into the larynx and ensure the passage of food into the gullet behind.

The cavity of the larynx is lined by mucous membrane continuous with that of the pharynx above and the trachea below, but in the larynx the membrane has a double reduplication on each side. The upper folds cover delicate fibrous bands, and form the *false* vocal cords, *false* because they are not directly concerned in the production of voice. The lower pair of folds are the true vocal cords, and enclose strong fibrous bands of elastic tissue, known as the inferior thyro-arytenoid ligaments, which run from the arytenoid cartileges behind to meet anteriorly at the centre of the thyroid. Parallel with and outside these ligaments lie the thyro-arytenoid muscles, whose contraction relaxes the vocal cards. Between the false and the true cord on each side lies a ponch-like cavity, the ventricle of the larynx, which in life plays the part of a resonating chamber. In order that sound waves may be formed, the vocal cords must be parallel, and have a current of air passing between them ; they must also be more or less tense, and the pitch of the voice depends upon the degree of tension of the vocal cords. In ordinary speech the larynx is concerned with the production of those consonants which are voiced, and of all the vowels, whose differences depend upon adventitions sounds formed by the tongue, or lips, the mouth, nose, and the pharynx.

Voice is sound generated in the larynx. Generally speaking, the smaller the size of the larynx, the higher the pitch of the voice and *vice versa*. Until the age of six until nearing the period of pubarty, the larynx is approximately smaller in size in both sexes ; but in adults the larynx is about a third larger in males than it is in females.

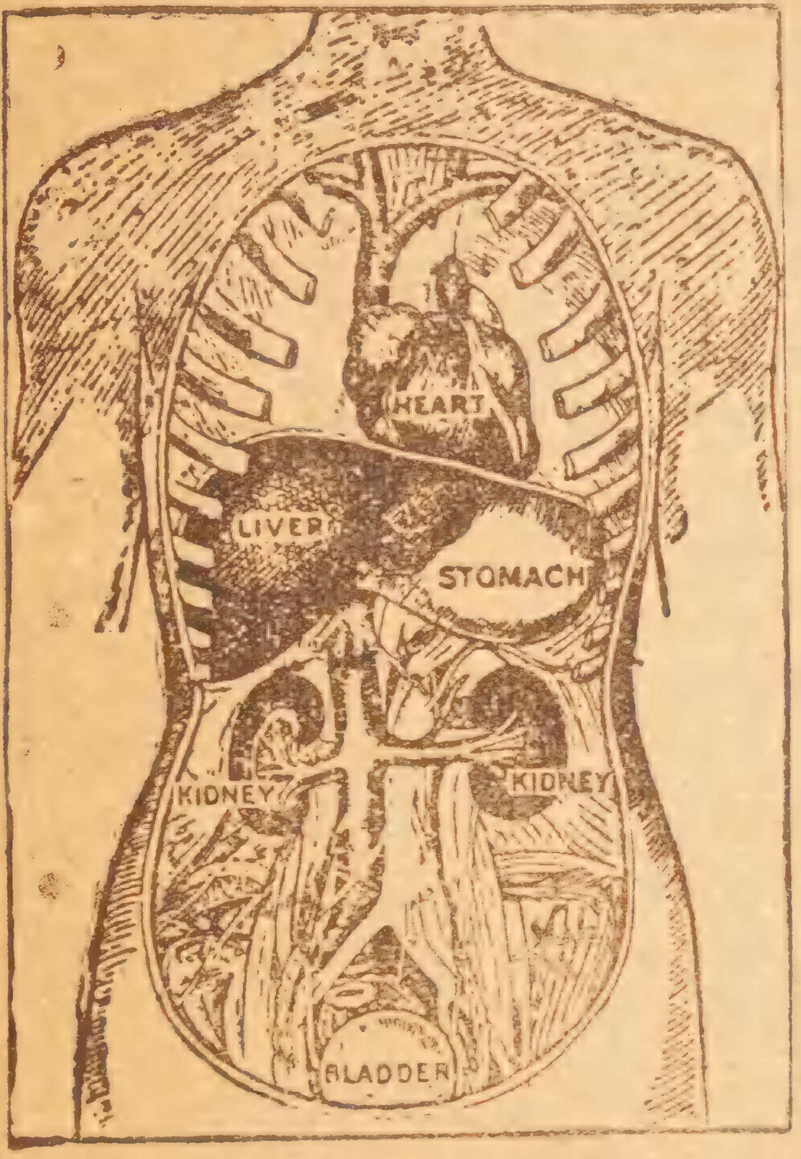
The first essential to correct voice production is the proper management of the breath, The voice is said to be correctly 'placed' when it is directed towards the frontal portion of the roof of the mouth, and a sense of strong vibration is felt in the bridge of nose. The sounds produced by an individual voice vary in volume and quality according to the strength of the air current which causes the vocal ligaments to vibrate, and the extent to which the tone is reinforced or modified in or by the resonating chambers of chest, throat, mouth and nose.

The Pharynx is the formel-shaped ponch lying above the gullet, having seven openings into it. These are the two posterior nostrils, the two eustachian tubes, the large opening into the mouth, the laryngeal slit, and inferiorly the opening into the gullet, which is continuous with it below. Between the pharynx and the oral or buccal cavity are the uvula above ; at each sides the pillars o the fauces, with the tonsils between them ; and below, the epiglottis, a thin, leaflike fibro-cartilege at the back of the tongue, whose function is to prevent food from entering the wind-pipe. Posteriorly the pharynx is loosely attached to the spinal column, and the larynx lies in front of its lower portion.

The neck is a solid cylinder of muscles, blood-vessels and nerves. It has a bony axis running through its back. It consists of the cervical region of the vertebral column, protecting the spinal cord, and supporting the head. It is coverd by masses of muscle for keeping the head erect or drawing it back. Through the front part of the neck runs the wind pipe, which is made up of a number of cartilegeous rings placed one over another, behind the wind-pipe and in close proximity to it runs down the œsophagns, a soft muscular tube. On both sides of the neck are large muscles, some of the blood-vessels of which the carotid arteries and the jugular veins are the most important, each side being a duplicate of the other. The former are placed internally and the latter externally. The remaining portion of the neck is made up entirely of strong bands of muscles.

CHAPTER III.

THE TRUNK.



The trunk of the body is made of a framework of bones covered by muscles and skin and is divided into two by a partition called the diaphragn. The upper and smaller part is called the thorax or chest, while the larger or lower part is known as the abdomen or belly. In this rounded box or trunk are secured the organs which manufacture the heat to warm the body, and the material to repair and nourish. In the middle of the thorax is found the heart and on each side of the heart are the lungs.

The heart is a hollow conical muscle, about the size of a man's fist. It consists of involuntary but striated muscular fibres. Although hollow it feels almost solid, because of the thickness of its walls. It is divided by a thick medium septum into two, a right side and a left side, and each side is again divided by valves into two chambers--an auricle and a ventricle. The cavities on one side have no direct communication with those on the other, excepting that conveyed by the coronary arteries. The heart is completely enveloped in a closed sac of serons membrane termed the pericardium. This membrane secretes a fluid which is constantly being poured out over the surface of the heart to reduce friction. The inside of the heart also is lined by a membrane called endocardium. The upper chambers of the heart, termed auricles, have thin walls, while the lower chambers or ventricles are thick-walled. The auricles are separated from, and open into, the ventricles by means of transverse constrictions each of which is strengthened by a fibrous ring. These form the auriculo-ventricular openings to the edges of which the valves of the heart, the mitral and the tricuspid valves which close or open these cavities are attached. The right auricle communicates directly with the superior and inferior vena cavae, while the left auricle communicates with the four pulmonary veins. The walls of the left ventricle are much thicker than those of the right. The dilatation of the chambers is called diastole and their contraction systole. The contraction of the two auricles takes place simultaneously followed by the simultaneous contraction of the ventricles. The blood in the right auricle contains more carbonic acid and less oxygen than that in the left auricle.

THE HEART.

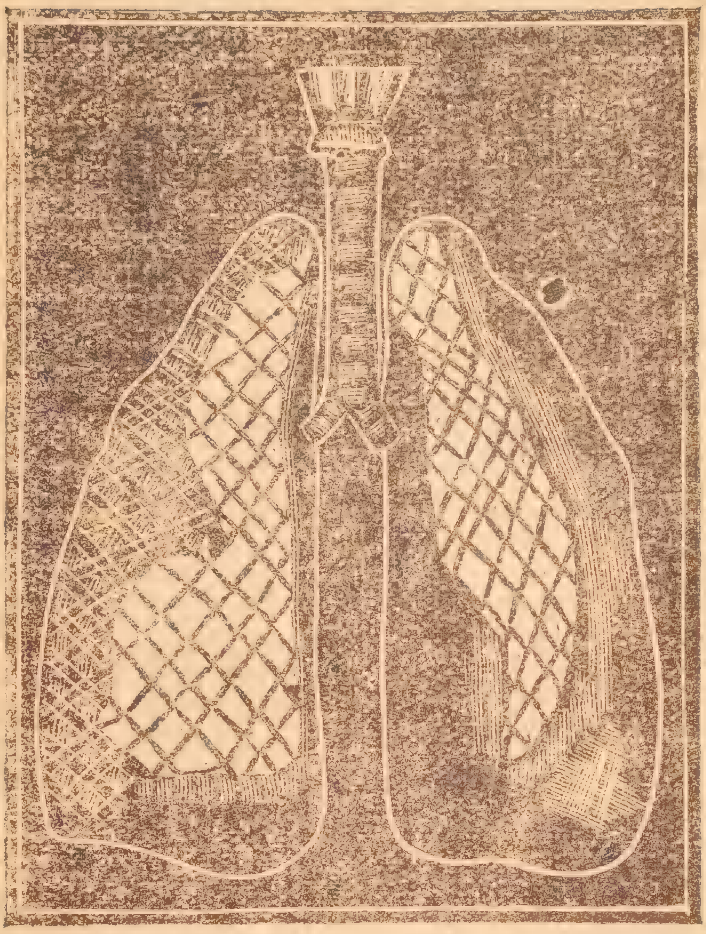
There are thick muscular columns projecting from the sides of the ventricles. These are the papillary muscles and columnae carneae. Small tendinous cords called chordæ tendineae connect the former with the flaps of the tricuspid and mitral valves.

During the auricular systole the blood from the right auricle enters the right ventricle, the tricuspid valve prevents the blood from again reaching the auricle, and it is therefore forced into the pulmonary artery As soon as the ventricular systole is over by the elastic recoil of the pulmonary artery, the semilunar valves are closed and the blood passes to the lungs.

The heart is supplied with nervous influence from other sources. In the substance of the heart itself are lodged a number of nervous ganglia and nerve fibres which form the medium through which its action is excited and maintained rhythmically. It is further regulated by impulses from the medulla through the branches of the pneumogastric and the sympathetic nerves. The former diminish, while the latter accelerate, the rate of the heart's beat.

There are again two more minor valves connected with the heart—the eustachian and the coronary valves. The former is placed at the entrance of the inferior vena cava into the right auricle; the latter is at the mouth of the dilated portion of the coronary vein. During the period of the ventricular systole, the apex of the heart is filted against the chest wall causing what is called the cardiac impulse or apex-beat.

The heart is the muscular pump which, by alternately contracting and dilating, maintains the circulation of the blood. The base of the heart lies in the median line of the thorax on a level with the third rib but its apex lies between the fifth and sixth ribs on the left side. It thus occupies an oblique position in the thorax between the lungs.



The *lungs* are the principal organs of respiration and are situated in the thoracic cavity. They are conical, with the base resting on the diaphragm and the apex extending above the collar-bone. In color they are pinkish gray mottled with black. They communicate with the external air by the trachea or windpipe, which bifurcates to form a right and a left bronches, each of which divides and subdivides throughout the entire lung. The right lung is the larger and heavier, and is divided into three lobes—upper, middle and lower. The left lung has only two lobes, and is narrower than the right on account of the position of the heart, which lies between the two lungs, but inclines to the left side

Externally each lung is covered by a double serons sac, the pleura. The outer surface of the outer layer of the pleura is adherent to the chest wall, and is called the parietal or sometimes the costal layer; while the inner surface of the inner layer is closely adherent to the lung, and is known as the visceral or pulmonary layer. The inner surface of the parietal and the outer surface of the pulmonary layers are smooth and glistening, so that one can glide over the other during the movements of respiration. The interspace between the two layers is the pleuritic cavity, but in health the two smooth surfaces are separated only by a little serous fluid, which acts as a lubricant.

The bronchi are circular cartilaginous tubes, which by successive subdivisions diminish until their diameter is only about one-fortieth of an inch, when they lose their circular form, and terminate in irregular passages, on the sides of which are the small air-sacs known as *alveoli.* The walls or septa between neighbouring alveoli contain much delicate elastic tissue, and carry the pulmonary capillaries, which are distributed in a very fine pot. Work with meshes smaller than the vessels themselves. The blood is thus spread over the alveolar walls in a thin layer, and is separated from the air contained in the alveolus only by the delicate capillary wall and the equally delicate epithelial cells which live the alveolus. All the alveol communicate directly with the ultimate divisions of the bronchi.

The blood supply to the lungs is double, one set of vessels, the bronchial being nutritional, while the pulmonary vessels are concerned with the process of respiration, and are therefore functional. The bronchial arteries are comparatively small. Springing from the thoracic portion of the aorta they accompany the bronchial tubes, and supply with arterial blood the lung tissue and bronchial glands as well as the bronchi themselves. The pulmonary artery is a large vessel which carries impure blood from the right ventricle of the heart. Like the trachea, it bifurcates and the right and left divisions pass to their respective lungs with the bronchi which they accompany, dividing and subdividing in similar fashion until they terminate in the dense capillary network round the alveoli. The pulmonary blood after being purified in the alveolar capillaries, returns to the heart by four pulmonary veins. The pulmonary lymphaties are numerous. The pulmonary nerves arise from plexuses, which are chiefly formed by branches from the vagi and from the sympathetic system.

All living cells require oxygen for their nourishment, and for the continuance of life the blood must constantly renew the supply of oxygen, and at the same time part with the carbon dioxide which it has washed out of the tissues. The red cells of the blood are the carriers of oxygen, which unites temporarily with the hæmoglobin contained in these cells, and gives arterial blood its characterestic bright red color, venous blood being dark and purplish. In pulmonary respiration the act of inspiration is effected by enlargement of the thoracic cavity, through the muscular contraction of the diaphragm and the intercostal muscles which stretch from rib to rib. The lungs play a passive part in inspiration. Being practically elastic bags, they follow the retreating chest walls and floor, with the result that air is drawn in through the trachea. In the expiration of ordinary breathing, the diaphragm and intercostals being relaxed, the elasticity of the lung causes it to contract, and drives out some of the contained air. In ordinary breathing about 30 cubic inches of tidal air pass in and out of the adult lung at each respiration, but an additional 100 cubic inches of supplimental air can be expelled by forced expiration. There remains about 100 cubic inches of residual air, which no effort can drive out of the lungs. At the end of ordinary inspiration the lungs thus contain 230 cubic inches of air, to which a further 100 cubic inches of complemental air can be added by a deepdrawn, prolonged inspiration. In ordinary breathing the tidal air is only one-eighth of the total contained in the lung, the remaining seven-eighths being stationary. Expired air differs from inspired in being warmer, moister and in having about 5 per cent more carbon dioxide and 5 per cent less oxygen. About 400 cubic feet of air pass through the lungs of an adult in twenty-four hours, in which time about 9 ounces of water and 8 ounces of carbon in the form of carbon dioxide are exhaled. In ordinary breathing the respiratory act accurs about 18 times per minute (15 according to our ancient sages), but exertion and exposure to cold accelerates the breathing and at the same time hasten the movements of the heart, so that a greater volume of blood is poured through the lungs per minute.

The nervous centre for respiration is situated in the medulla oblongata and appears to be chiefly stimulated by venous blood, the active agent being probably the free carbon dioxide in the blood which bathes the nerve cells. When the blood, therefore, is sufficiently charged with carbon dioxide to irritate or stimulate the respiratory nerve-cells, or to paralyse controlling cells which inhibit them, impulses are transmitted to the inspiratory muscles, whose contraction replaces the excess of carbon dioxide by a fresh supply of oxygen Other stimuli, however, act upon the centre; thus cold water dashed upon the chest causes strong involuntary inspiration, and within certain limits both inspiration and expiration are under voluntary control. Asthma, Bronchi, Cirrhosis. Emphysema. Phthisis, Pleurisy and Pneumonia are some of the diseases

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of the respiratory apparatus. Gangrene of the lung is a rare disease.

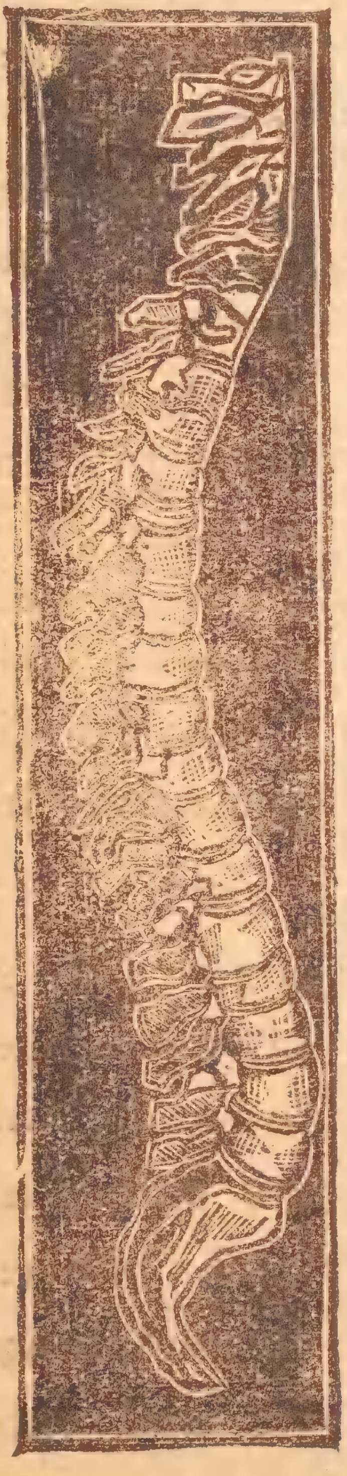
The diaphragm or midriff is the muscular curtain separating the chest or thorax from the belly or abdomen. It is a musculo-fibrous structure forming the floor of the thorax and the roof of the abdomen. It is attached by its circumference to the front of the lumbar vertebræ, the inner surface of the six or seven lowest ribs and cartileges, and to the back of the breast-bone (sternum) at its tip. The centre of the diaphragm joins above with the pericardium or sac enclosing the heart. The diaphragm is pierced by the æsopogus, the aorta and the inferior vena cava. It is constantly at work during respiration, and is the muscle chiefly responsible for the act of inspiration or indrawing of the breath. It is convex towards the thorax and concave towards the abdomen. Its centre consists of a sheet of tendon to which bands of striated muscles are attached all round. These muscular bands form the greater part of the diaphragm and make it in reality a muscular partition tendinous at the centre only. Like other muscular tissues, the muscular portion of the diaphragm is capable of contraction and this will cause it become less convex, whereby the thoracic cavity will be increased, causing the lungs to expand and contributing to diminish the pressure of the air in the lungs, and the inrust of the external air. This is inspiration with the relaxation of the diaphragm its original convexity is restored, the lungs are slightly pushed up and the tidal air is driven out causing expiration.

Before dealing with the viscera of the abdomen, it will be of utility to study the trachea, the œsophogus the vertebral column and the spinal cord.

The Trachea or windpipe is a nearly cylindrical tube, composed of cartilaginous and membranous tissues and extending downwards from the lower part of the larynx to the level of the third dorsal vertebræ, where it bifurcates into the two bronchi. It is about four and a half inches in length and about three-quarters of an inch in diameter. It lies upon the œsophogus posteriorly, and is in relation with the carotid arteries, the thyroid gland and its vessels, and the recurrent laryngeal and pneumogastric nerves. It is supported and kept open by sixteen to twenty imperfect cartilagnious rings. Each cartilgnious ring is a flattened band, the ends of which are connected together along the back of the trachea by plain muscular tissue. Its external coat consists of connective tissues containing a little fat. Its internal coat is mucous membrane, consisting of an internal epithelium resting on a layer of connective tissue. The epithelium consists of cells, the surface layer of which are columnar and bear a large number of short hair-like processes called cilia which, during life, are constantly in a wavy motion.

The œsophogus or gullet is the passage from the mouth to the stomach. It forms a portion of the alimentary canal beginning at the mouth and ending at the anus, through which food passes in the course of eating and digestion thus embracing the salivary glands, pharynx, thyroid gland, thymus gland, lungs, œsophogus, diaphragm, stomach, liver, pancreas, small intestines, ileocecal valve, vermiform process, ascending colon, transverse colon, descending colon, rectum, and anus. It is composed of gristly rings which keep the tube always open, however you may move your neck.

The food reaching the pharynx is gradually propelled downwards to the stomach by the contraction of the circular muscles in the walls of the œsophogus known as peristaltic action. The muscles receive impulse by a sort of reflex action. These muscles are made up of plain or nonstriated muscular fibres.



The vertebral column or Backbone or spinal column consists of thirty-three bones of which in the adult the four lowest are united to form the coceyx, and the five above it are fused together as the sacrum. Of the others, the seven highest, which are situated in the neck, are called cervical; the next twelve lie between the shoulders and the waist, and are known as the dorsal; while the remaining five, the lumbar vertebræ, are situated immediately above the sacrum. Each vertebra consists of two essential parts—an anterior solid segment or body, with concave surfaces above and below, and a posterior hollow segment or arch. The vertebræ are superimposed one upon the other, so that the bodies make a strong solid pillar, while the arches form a continous bony canal behind. Between each pair of vertebræ apertures exist for the spinal nerves arising from the spinal cord within the canal. The two highest cervical vertebræ present characteristic modifications in connection with the movements of the head, the upper being known as the atlas and the second as the axis. The *atlas* has no body, but is a mere bony ring, capable of rotation around the odontoid process of the axis. The *axis*, for its body, carries a process which goes into the inner side of the front part of the ring of the atlas. This process as a smooth part and so has the ring itself, and the atlas can move round for a considerable way on the axis, with the odontoid process as a pivot This process is kept in place by a ligament lying just behind it, across the ring of the atlas and this separates the process from the spinal cord which passes through the ring. The lower surface of the atlas has also two surfaces by which it forms joints with the axis, as do the other vertebræ to one another ; it is the looseness of these joints which allows the atlas to turn on the axis as far as it does. The upper surface of the atlas has two smooth surfaces on which the skull rests. These are joints to allow a backward and forward movement of the skull on the atlas which is kept fixed. The two check ligaments passing from the top of the odontoid process to the skull limit the amount of rotation of the atlas. Strong ligaments also connect the occipital bone with the axis and with the atlas.

All the cervical vertebræ have the transverse process on each side pierced by a foramen, through which the vertebral artery and vein pass. The spine is thick and horizontal in direction. It furnishes attachment for the strong ligament of the neck. Its average length is about two feet two inches Viewed laterally, the spine presents several curvatures which correspond with its different regions. The cervical curve is the least marked, and is concave backwards, the dorsal is concave forwards, the lumbar is concave posteriorly, while below the lumbar region the sacrum and coceyx form the pelvic curve, which has its concavity looking forwards. From the greater traction exercised by the muscles of the right arm, the dorsal region of the spine general presents a lateral curvature, the convexity of which is towards the right side, and also a slight compensatory curve of an opposite nature in the lumbar region. The cartileges between the vertebrae form in the aggregate nearly one-fourth of the total length of the spine; but they are not uniform in thickness, being thinner in the dorsal than in the cervical and lumber regions which have, consequently, greater pliancy and mobility. The ligaments of the spinal column are mostly characterised by the large amount of elastic tissue which they contain, and which serves to maintain the upright position with but little expenditure of muscular energy. The spinal column is the central support for the framework of the body. The maximum of movement between two adjacent vertebrae is very slight, but the aggregated movements of several such joints amount to a considerable range of mobility. The curvature of the spine adds to its strength, and confers upon it the properties of an elastic spring. It thus dissipates the force of a fall instead of transmiting it to the head has a rigid and straight column would do. The spine also forms an armoured flexible tube for the protection of the delicate spinal cord.

The Spinal cord is the elongated cylindrical part of the nervous system enclosed in the backbone. It is usually about sixteen inches in length, and dose not nearly fill the spinal canal, its investing membranes being separated from the bony wall by areolar tissue and a plexus of veins, as well as by cerebro-spinal fluid, while in the adult it does not reach lower than the first lumbar vertebrae, where it terminates as a slender thread of gray matter. It is supposed to terminate at the edge of the hole in the skull where the column enters to join the brain. At this point, it is expanded both in width and depth and receives additions of gray matter. The expanded portion about 1¼ inch In length is known as the *medulla oblongata*, the centre of important nerves.

The cord is a flattened cylinder with a deep longitudinal furrow or fissure on both the anterior and posterior aspects. These fissures divide the cord into symmetrical halves, which are united in the middle line throughout their whole length by a transverse band of nervous substance. The cord is seen to consist of white and gray matter, of which the white lies externally, and constitutes the greater part. The gray matter is arranged somewhat in the shape of a crescent in each half of the cord, the two crescents being united near their middle by the gray matter which passes across the commissure. Both the white and gray matter contain a supporting tissue—neuroglia consisting of elastic fibres and nucleated cells. The nerve cells are large and multipolar, possessing many processes, which break up like the branches of a tree into fine nerve networks. The cord is supplied with a large number of blood-vessels which, with the ganglion cells are surrounded by lymph spaces. It is enveloped in three memberanes—the dura matter, the arachnoid membrane, and the pia mater, composed of fibrous connective tissue aud endothelium. The white medullated fibres which join the anterior pyramids of the medulla oblangata decussate almost entirely before entering the spinal cord. The nerve filaments of the white matter depend for their vitality upon the cells from which they spring. Throughout the entire length of the spinal cord sensory fibres cross from one side to the other.

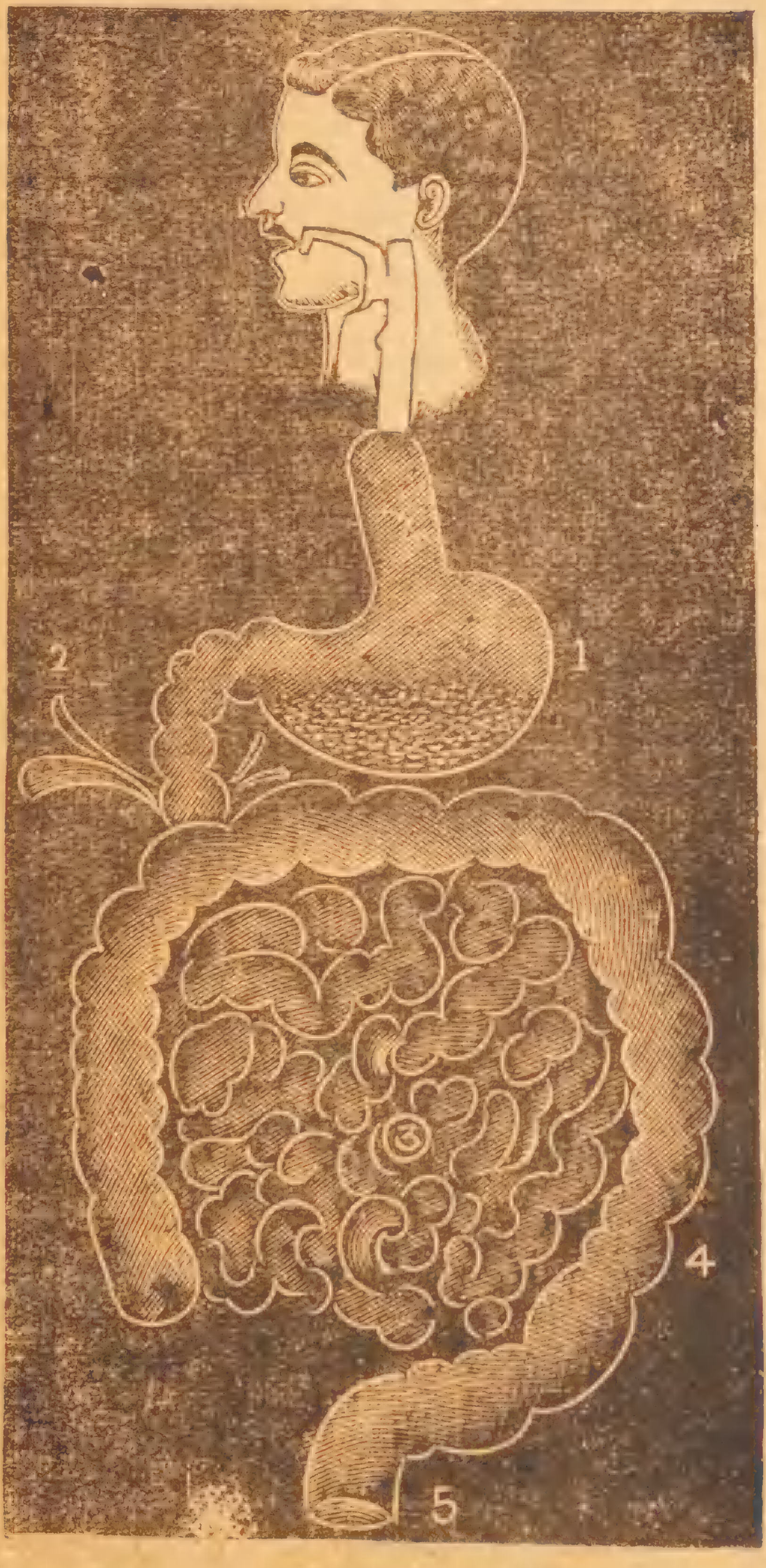
The functions of the spinal cord are known to be these:—

1. It is the main trunk of all the nerves distributed to the body generally. Its destruction or severance at any part puts an end to all communication with the members supplied with nerves below the point of severance; whence follow paralysis and loss of feeling.

2. It has the function of a centre, *i. e.*, it completes a circle of nervous action, so that certain movements, in answer to stimulants, can be kept up by means of it alone. This property is allied with the inside core of gray matter.

The larger and lower part of the trunk is the abdomen or belly. In this rounded box are secured the parts or organs which manufacture the heat to warm the body, and the material to repair and nourish. The abdominal viscera are the stomach, the liver, the pancreas, the spleen, the kidneys, the intestines and the urinary bladder.

The stomach has two openings—(1) cardiac orifice, which communicates with the gullet; and (2) the pyloric orifice, which opens into the duodenum, and is guarded by the pyloric valve. The anterior surface of the stomatch is in relation to the liver, the diaphragm, and the abdominal valve; while the posterior surface is in contact with the pancreas, the crura of the diaphragm, the great abdominal vessels, and the solar plexus. The organ is held in position by the omenta (the free borders of the peritoneum—the serious membrane linning the abdomen), which permits of comparatively free movements and of expansion. The wall of the stomach consists of four coats—a serous, muscular, callular, and mucous coat. The mucous coat of the stomach is thick, with a smooth velvety surface, pinkish in youth, but gray or straw-color while at rest in the adult, but red during gastric digestion. The surface of the mucous membrane presents a honey-comb appearance, being covered with small shallow depressions or alveoli. Throughout its entire extent the mucous membrane is covered by a single layer of narrow, cylindrical epithelial



cells, which are somewhat goblet-shaped and seen to secrete mucous, numerous glands of two distinct varieties are placed vertically like rows of test tubes embedded in the mucous membrane, and open by ducts at the bottom of the alveoli. The glands at the cardiac end of the stomach are variously known as peptic, cardiac or fundus glands. The pylorus glands occur only in the region of the pylorus and have longer ducts and mere patent lumina than have the fundus glands. The ingestion of food stimulates the gastric juice to secretion. Alcohol in moderation increases, in excess arrests, the flow. The chief function of the stomach is to prepare the food for abserption by the intestine by mechanical and chemical means. Its muscular walls undergo a series of wavelike movements, whereby the food is churned up, mixed with the gastric secretion from its glands, and finally forced into the intestine as chyme through the ring of the pylorus, the contraction of which retains the food in the stomach while gastric digestion is proceeding. The chemical part of the Stomach's work is performed by the gastric juice, which contains a ferment termed pepsin and free hydrochloric acid, the chief digestive constituents. The juice is a clear, colorless fluid with a strongly acid reaction, sour taste and characterestic odour. The gastric juice commences to trickle into the stomach as soon as the taste of food in the mouth is perceived. In normal digestion, the glands in the wall of the stomach respond but slightly at first to the arrival of food and saliva, but about fifteen minutes after the food has been swallowed the gastric fluid is secreted more freely. At first the hydrochloric acid is present only in sufficient quantity to neutralise the alkalinity of the saliva, but later the whole contents of the stomach are rendered distinctly acid. The action of the gastric juice is upon those groups of foods known as albuminates and albuminoids. Pepsin (a secretion from the glands in the mucous membrane), has the power in acid solution, of converting proteids into soluble peptones. It forms a very small part of the gastric juice, and is always closely associated partially transforms the insoluble albumin of flesh foods and legumes into peptone, and the gelatin of jellies into gelatine-peptone. This transformation contributes very largely to the assimilation of such foods. The hydrochloric acid of the gastric secretion, besides assisting in these processes of digestion, plays the part of a germicide, and prevents such abnormal fermentations as lead to the production of lactic and butyric acids. After the food is churned in the stomach for from three to four hours, it is reduced to the condition of chyme.

The liver is the largest gland in the body, weighing nearly four pounds, and measuring about eleven inches in transverse diamter. Its upper surface is convex, and lies in contact with the diaphragm above ; while its lower surface is concave, arching over and touching the stomach, intestine, and right kidney. In shape the liver is irregular, being thickest from above downwards upon the right side, and extending in wedge fashion towards the left. It is also thicker posteriorly, and presents in front a thin edge which is marked by a deep notch. The right lower border corresponds with the margin of the ribs, but its position varies to some extent with the movements of the diaphragm, to which the liver is attached by ligaments, formed by folds of the peritoneal covering, which also dips into the fissures. Five fissures on the under surface of the organ divide it into a corresponding number of lobes, and in one of the anterior fissures lies the gall-bladder, a pear-shaped membranous sac about 4 inches in length and one inch in breadth at its widest part. One of the fissures on the posterior border of the liver is occupied by a portion of the inferior vena cava, which receives the blood from the hepatic veins before it passes upwards through the diaphragm. The blood supply of the liver is complicated. Like all other animal tissues it requires artificial blood. Amongst the functions of the liver are the elaborataion and the storing up of certain products of digestion which are brought to it by the portal vein. This large venous trunk by the union of the four intestinal veins—the superior and inferior mesenteric, the gastric and the splenic, which contain blood charged with food extractives, and reaching the liver it ramifies like an artery within the substance of that organ. The liver substance consists of innumerable distinct lobules which longitudinally are oblong, but transversely present a polygonal surface. The liver is plentifully supplied with lymphatics, and with nerves largely derived from the sympathetic system.

Bile, a golden-yellow fluid, intensely bitter in taste and alkaline in reaction, is now regarded more as an excretion than a secretion, being a by product formed by the liver-cells in the course of manufacture of more important compounds. Receiving, as it does, the blood from the alimentary canal, the liver subjects the food to a second digestion, and while retransmitting through the hepatic veins to the general circulation whatever is required for immediate use, it retains and stores up any surplus, which it subsequently doles out to the tissues are required. The substance which is thus manufactured and passed on to the blood is a sugar called gloucose, and the excess is stored up in the liver cells in the form of glycogen. One more function of the liver is the regulation of the number of red blood corpuscles. During faetal life great numbers of red blood cells are produced in the hepatic capillaries. After birth, however, the liver assumes the opposite role in the economy of the blood, destroying the old and effete red corpuscles, whose haemin and other iron-free pigments it excretes with the bile, the iron of the haemoglobin being retained for subsquent use. One more function of the liver is that of arresting the various poisonous substances which have found their way into the blood.

Jaundice and gall-stones are the commoner diseases of the liver-cirrhosis and new growths of the liver and bile passages are not infrequent.

The pancreas is an abdominal organ concerned in digestion. It lies just below the diaphragm, and for the greater part closed behind the stomach. It is a compound racemose gland, and in structure analagous to salivary glands. It secrets a fluid known as pancreatic juice, which passes along the pancreatic duct into the duodenum, and emulsifies fats, converts starch and sugar into glucose, and changes proteids into peptone, in which form they are obsorbed through the intestinal walls. It is alkaline, and the secretion is exited reflexly by the passage of food into the stomach becoming more abundant when the stomach -digested food (chyme) begins to pass into the duodenum. The organ is liable to acute and chronic inflammation. Its complete removal produces diabetes.

The *spleen* is a small organ lying high on the left side of the abdomen, partly behind the stomach and the intestine. It is of soft, pulphy tissue, in a meshwork of fibrous and elastic substance, and is surrounded by an elastic capsule. It changes greatly in size by the expansion and contraction of its muscular fibres and according to the amount of blood which distends it. It tends to become distinded a few hours after a meal. Herein the white blood-corpuscles multiply by division. Many red blood-corpuscles are broken down there.

It may suffer from acute inflammation and hypertrophy. It is occasionally the seat of tubercular disease, career, and syphilitic changes.

The kidneys are the two excretory organs whose function is to get rid of nitrogenous waste. They are situated in the back part of the abdomen, one on each side of the lumber portion of the spinal column. Each is somewhat bean-shaped, presenting its concave border towards the spine. The peritonium covers their anterior aspect. Each is about four inches long, two inches broad, and one inch thick, the left being slightly the larger. In the central part of the concave border is a notch known as the hilum, through which enter the blood-vessels, nerves and lymphatics, and from which arises the ureter or excretory duct. Over the upper end of each kidney is situated small ductless gland, the supra-renal capsule. The function of the supra-renal bodies is imperfectly known, but their destruction by

disease is followed by grave and fatal constitutional symptoms. The function of the kidneys is the secretion of urine, which consists of water containing urea and the various other waste products that result from body metabolism (chemical change in living cells,) and are carried to the kidney by the blood in the renal arteries. The average amount of urine secreted in 24 hours is fifty ounces, (in addition to 6 ozs. by the lungs and 18 ozs. by the skin), containing about 500 grains of urea and other solids, consisting chiefly of phosphates, urates, chlorides, sulphates, oxalates, and uric acid, with traces of more complex substances.

The arterial blood goes into the substances of the kidneys consisting of a large number of uriniferous tubules ending in special dilatations called malpighian capsuls. The blood capillaries of the renal artery traverse the walls of the tubules and also form loops called glomerulus in the said capsules. The walls of the tubules absorb a certain quantity of water and nitrogenous waste matter from the capillaries found on them, and the thin walls of the malpighian capsule filter or eliminate a greater quantity of water and nitrogenous matter from the glomeruli. Thus the blood that is to leave the kidneys is thoroughly altered in composition and is quite different from that which entered them. The blood that is found in the renal veins is the purest in the body.

Urine is a pale-yellow fluid with an acid reaction, secreted from the blood by the kidneys, stored through the two ureters in the bladder, and voided periodically, generally at will, through the urethra. All the ingredients of urine vary according to the health, food, and physical conditions of the person, and the climate, Many diseases readily manifest themselves by ingredients found in the urine. Hence the valve of urine-analysis in pathology. Urine is often specifically named from its appearance or character, especially as indicative of morbid bodily conditions ; as diabetic urine, dropsical urine, gouty urine, milky urine, rickety urine, smoky urine, &c. Malformations of the kidneys, floating kidney, nephritis or inflammation, renal colic are some of the diseases connected with the kidney. Diabetes, although producing great changes in the chemical constitution and in the quantity of the urine, is not due to disease of the kidneys.

The intestine or bowel is that part of the alimentary canal which, commencing at the pyloric end of the stomach, is coiled in the abdominal cavity and ends at the anus. It occupies a greater portion of the abdominal cavity. Although a single continuous tube, it is divided into various parts for purposes of description. Food leaving the stomach passes first into the duodenum, thence into the jegunum, and later into the ileum. These three portions form the small intestine, which in man is folded over and over, about thirty feet in length. The opening of the ileum into the cæcum, the first part of the large bowel, is valvular, and this arrangement contributes to the onward passage of the intestinal contents. Beyond the ileo-cælaly valve the cæcum forms a blind dilatation, and from it springs an elongated blind process, the vermiform appendix. The cæcum continued upwards, as the colon, which is described as (1) ascending, (2) transverse and (3) descending. The sigmoid flexure lies between the descending colon and the rectum, whose lower opening, the anus, is guarded by a strong circular muscle the sphincterani. The large intestine is of greater calibre than the small, and measures about 5 feet in length. It is divided as shown above into caecum, colon and rectum.

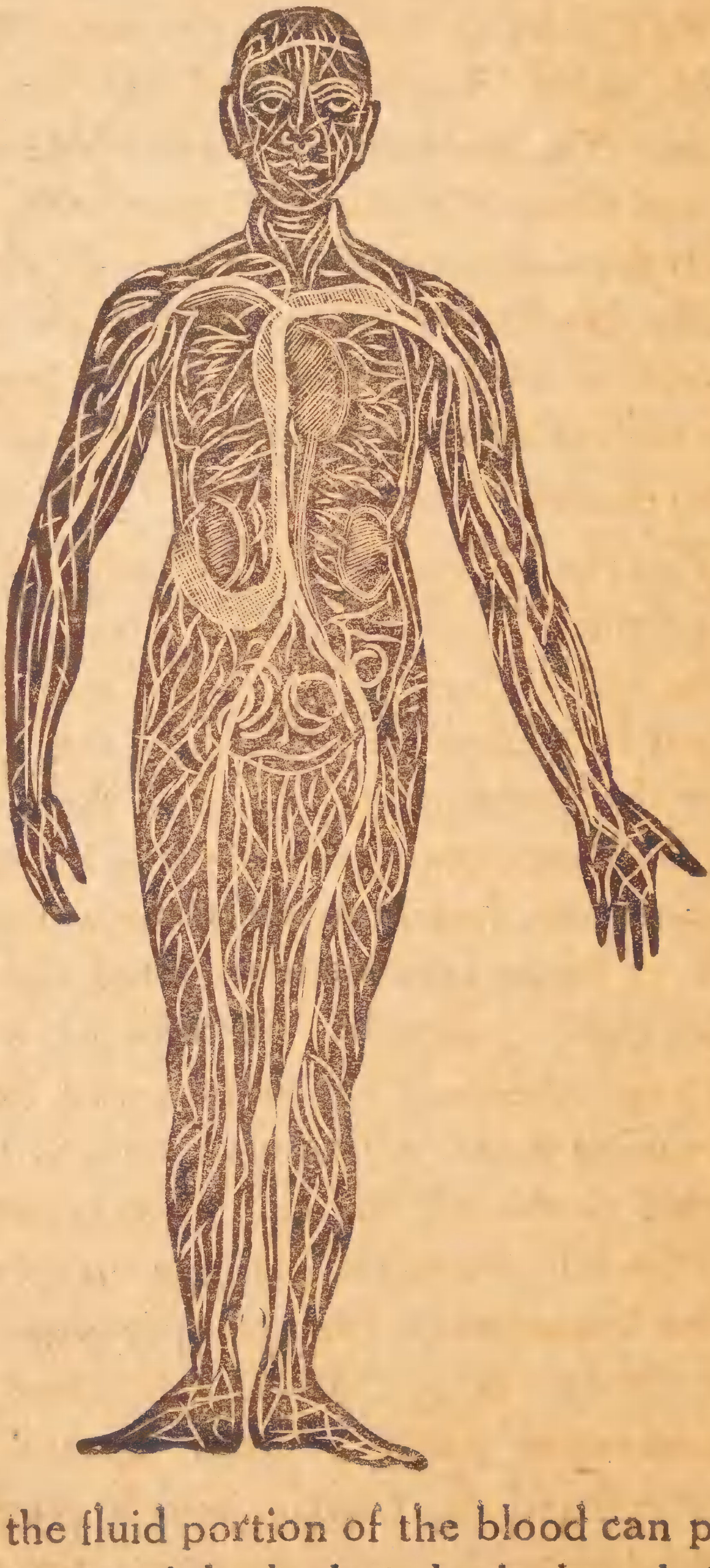
The intestines are covered by a serous membrane, the peritoneum, and are loosely attached to the spine by the mesentary. Within the peretoneal covering are muscular and mucous coats. The muscular fibres are arranged in two layers. In the internal layer the fibres are laid circularly forming the circular layer of muscle, while in the external layer the fibres are disposed along the length of the intestine forming the longitudinal layer of muscle. When the muscle fibres of the circular layer contract at any place the size of the intestine at that place is diminished and the contents of the intestine are pressed out of that part. The longitudinal muscular layer assists in the movement. During life the muscular fibres exhibit peristaltic contraction, the upper fibres contracting before the lower, so that the intestinal contents are constantly pushed onwards by the wavelike narrowing of the bowel. In the mucous coat are numerous glands which secrete the intestinal juices. Some of these glands are solitary, but in the small intestine many are aggregated to form patches (Peyer's glands) The intestinal secretions are augmented by those of the liver and pancreas, which have a common opening into the duodenum. The interior of the small intestine is characterised by the presence of villi, which are minute projections into the lumen of the bowel. Each villus is covered by mucous membrane, and contains the commencement of a lacteal vessel, by means of which digested food (now termed chyle or lymph plus digested fat) is absorbed and transmitted through the lacteals to the blood stream. Some of the material absorbed passes to the liver by the portal vein. The large intestine contains no villi. The bowel is abundantly supplied with blood and lymph vessels, which reach at through the mesentary and the intestinal nerves are derived from the sympathetic system. The chyle, which is the last to leave the digested tube, is conveyed to the blood at the root of the neck on the left side (the jugular vein).

Owing to the interdependence of different organs, the alimentary system is peculiarly prone to be deranged as a secondary result of disease elsewhere. Owing to the close relationship existing between the alimentary canal and the central nervous system, headache, depression, irritability and other mental symptoms arise as the result of intestinal derangement. On the other hand, mental impressions frequently produce intestinal symptoms, such as diarrhæa, suppression of the normal secretions, generation of large quantities of flatus, or even ulceration. Again, from their anatomical structure and relations, the intestines are liable to a special class of accidents which are largely the result of their mobility and muscularity—as volvulus, hernia ; and numerous others are produced by the traction or by the pressure of other organs and of tumours. From the diversity of the tissues which form the intestinal wall, the bowel is subject to the development of numerous varieties of new growth, many of which are malignant. Inflammatory conditions of the bowel are common, and present many types—enteritis, appendicitis, dysentery, enteric fever, &c.

The urinary bladder is the reservoir for the urine. It is a musculo-membranous sac, situated in the pelvis, behind the pubes (the junction of the two innominate bones forming the front boundary of the pelvic cavity) and in front of the rectum in the male; in the female, the uterus and vagina lie between it and that intestine. In infancy it is conical in shape ; in the adult, when empty, it is a small triangular sac lying deeply in the pelvis, flattened backwards from the front. When slightly distended, it is rounded in shape ; when greatly distended, ovoid, and rises from the pelvis into the abdominal cavity. When moderately full it contains about a pint, but is capable of great distension, and has been known to hold twenty pints. It has three opening into it—those of the two ureters from the kidneys, and that of the urethra. The bladder is composed of four coats, which are from without inwards, the serous peritoneum, the muscular, the submucous, and the mucous. From the ureters the urine falls drop by drop into the bladder, and when it is almost filled, the sphincter muscles at the opening of the bladder into the urethra relax and the urine is expelled through the urethra out of the body.

The urethra is a membranous tube through which the urine is expelled from the bladder. In the female it is comparatively short and wide. In the male the channel is sinous, and being narrow, is more apt to be obstructed by calculi and by inflammatory affections, such as gonorrhea.

At this stage, it will be beneficial to look at the system of the circulation of blood. The system may be considered as double, being composed of a systemic (general) and pulmonary (lung) system of blood-vessels. Each system consists of arteries, capillaries and veins, and of a pump formed by two of the four chambers of the heart. Arteries are hollow, elastic tubes which carry blood from the heart. They divide, and subdivide, their ultimate divisions being the capillaries. The walls of these last are thin and delicate to allow of an interchange of gases taking place between the blood and the tissues.



Part also of the fluid portion of the blood can pass through, so that every part of the body is bathed and irrigated by blood-lymph. The stream of blood flowing through these vessels is constant, the elasticity of the artereial walls maintaining the blood pressure.

The capillaries join together to form venous rootlets, and these in turn unite to form small veins. Most veins have in their walls ponchlike valves, which prevent backward flow. The systemic capillaries bathe the tissues with lymph, and allow the blood to part with its oxygen and to take up the waste product carbon dioxide instead. The pulmonary capillaries surround the air vesicles of the lungs, and in these capillaries the impure blood exchanges its carbon dioxide for fresh oxygen from the air within the vesicles.

The heart is the muscular pump which, by alternately contracting and dilating, maintains the circulation of blood. The pulmonary and systemic circulations may diagrammatically represent two loops of a figure 8, the heart being situated where the loops meet. To trace the course of the blood stream, imagine a quantity of blood in the right auricle. The contraction of the heart begins in the auricles, so that the fluid is driven down into the still dilated right ventricle. The ventricle then contracts, and forces it into the pulmonary artery ; thence it passes into the capillaries of the lungs. Leaving these, it returns it returns by the four pulmonary veins to the left auricle, contraction of which drives it into the left ventricle, which in turn forces it into the aorta. The branches of the aorta convey it into all parts of the body except the lungs ; and from the capillaries of all these parts, except certain abdominal viscera, it is conveyed by vessels, which gradually unite into larger and larger trunks, into either the superior or inferior vena cava, which carry it to the right auricle once more.

The superior vena cava brings the blood from all the organs above the level of the heart, including the upper extremities. The inferior vena cava brings back the blood from the lower limbs and from the organs below the cardiac level, except the stomach, the intestine, the spleen and the pancreas. The venous blood from these organs is gathered into veins which unite to form a single trunk, the portal vein. The liver is a store house for many of the products of digestion, and the venous blood carrying these products from the stomach and the intestines is distributed by the portal vein to the liver, where it mingles in the capillaries with blood from the hepatic artery. The hepatic capillariesunite to form small veins and these form a single trunk, the hepatic vein, which opens into the inferior vena cava. The flow of blood from the abdominal viscera through the liver to the hepatic vein is called the portal circulation.

The heart derives its blood supply from the coronary arteries which spring from the root of the aorta. The blood from the heart capillaries is poured by the coronary vein directly into the right auricle. Obviously, this is the shortest route by which a blood corpuscle can travel round the systemic circulation ; the longest is through the capillaries of the intestine and those of the liver. The average time required for a corpuscle to travel from the right auricle through the pulmonary and systemic cricu-lations is about thirty seconds.

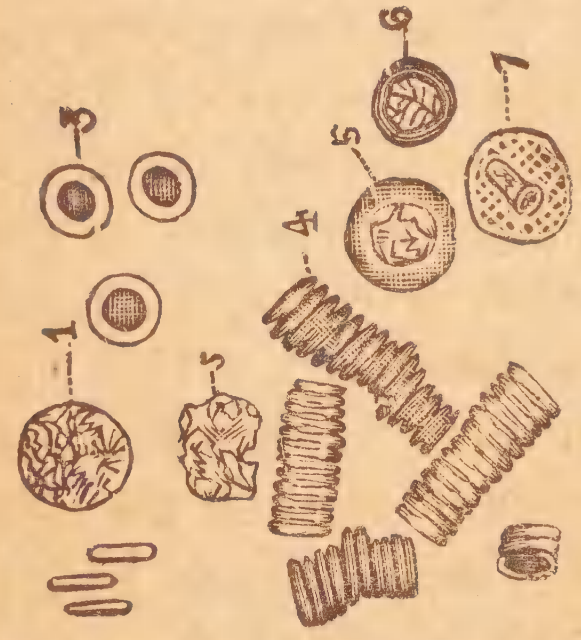
It has further to be stated that nutrition depends. upon not only digestion and absorption, but the more remote functions of respiration, circulation, secretion and excretion. The metabolism of an amæboid cell is comparatively simple, since it derives its oxygen and food from the fluid in which it wanders free. In multicellular plants and animals, however, the majority of the cells are fixed, and are differentiated for special purposes. Their fixation requires that nutriment be brought to them, and their specialization necessitates the elaboration of the pabulum into an assimilable form. In a nighly organised individual like man the blood and lymph are the media which carry oxygen and pabulum to the individual cells. The secretions of the various glands connected with the alimentary system transform the food into compounds, which may be either stored up for future use, or poured directly into the blood stream. By means of the circulation these compounds are brought into contact with the cells, each of which has a selective power of withdrawing from the lymph and blood the materials it requires for manufacturing its own special product, while it passes into the circulation the waste products of its activity. The ultimate nutrition and respiration thus take place not in the alimentray and respiratory organs, but in the cells of the various tissues. Individual cells have but a limited power of grouth in size, and up to a certain age absorption of pabulum in excess of the daily needs leads to multiplication of the cells, and consequent grouth of the whole organism. After adult life is reached the cells preserve between the recorpt and the expenditure of energy that balance which constitutes maintenance. If an amount of food in excess of the needs of an organism be digested, the surplus may be stored in adipose tissue, but it no longer leads to multiplication of the cells.

CHAPTER IV.

The nervous system in man includes the brain, the spnial cord, the nerves, and the end organs, as well as the various ganglia of the cerebro-spinal and sympathetic systems. Each nerve is constituted of a collection of nerve bundles surrounded by a sheath of connective tisssue, the perineurium; and the various bundless are bound together by bounds of similar tissue, the epineurium. The individual fibres within each bundle are attached to one another by more delicate connective tissue, the endoneurium. Each fibre presents a central thread, called the axis cylinder, a fatty medullary sheath and externally a primitive sheath. Of these three parts the axis cylinder is associated with the transmission of nervous energy, the medullary sheath is nutrient, while the primitive sheath supports and strengthens the more delicate parts within. Each fibre connects a central nerve cell with a peripheral end organ. Some nerve filaments terminate in muscular end plates, through which the stimulus for contraction is communicated to the muscle. Such fibres are called *motor* or *efferent*, since their nerve currents are carried outwards from the brain to the end plate Many efferent fibres end in glands, and may be either secretory or inhibitory, while others terminate in subordinate nerve centres. Of afferent filaments the end organs may be the corpuscular bodies in the skin, which are connected with the sense of touch, or they may be highly specialised cells of the retina, or those of the tongue, the nose and the ear. Closely connected with, but to some extent distinct from, the cranial and spinal nerves is the subsidiary sympathetic system, whose special province is the nervous supply of the blood vessels and the involuntary muscles. The leading characterestic of a nerve cell is its irritability; that of a nerve fibre is its faculty of transmitting waves of nerve energy at the rate of about a hundred feet per second. The transmitted impressions are correlated by the nerve centres, and from other centres in the cortex of the cerebral hemispheres impulses are disparched along the motor nerves, and produce contraction of the muscles. Many actions are, however, independent of consciousness. Such an act is 'reflex'. In the spinal cord are groups of cells called ganglionic centres, which make with the sensory and motor fibres a secondary nervous are between the sensory organs and the muscles. It is by means of these short nervous ares that reflex action is possible. Reflex action becomes imposible if either the sensory or the motor nerve be severed, or if the ganglionic centre be desrtoyed. Reflex action is not restricted to the spinal cord ; part of the nervous are may lie in the subordinate parts of the brain. Man's preservation of an erect attitude and the cardiac movements are reflex. Respriration furnishes an example of a reflex act which may be considerably modified by voluntary impulses.

Every time nerves transmit a message they undergo partial destruction, and even when at rest they require nutriment. They are therefore supplied with blood vessels, which ramify round them in microscopic networks, and with the nerves of the nerves. Each spinal nerve arises from two roots, an anterior and a posterior. Of these, the anterior contains motor, and the posterior sensory fibres. On each posterior root is a ganglion, which exercises a nourishing influence on the sensory fibres. The nature of the nourishing influence is most probably effected by rhythmic waves of nerve energy proceeding outwards from the nerve centre.

The sympathetic system of nerves forms a double chain of ganglia, one an each side, or slightly in front, of the spinal column. These ganglia communicate with each other and with the spinal nerves by delicate commissural threads. Nerves arise from the ganglia, and are distributed chiefly along the blood vessels. They also form considerable plexuses about the thoracic and abdominal viscera. Free intercommunication exists between the sympathetic and cerbro-spinal systems, and many of the sympathetic fibres are ultimately derived from cranial and spinal nerves and centres.



Blood is the red fluid which circulates through the heart, arteries, capillaries, and veins, supplying nutrition to all parts of the body, and conveying waste substances from the tissues to those organs by which they are excreted. Human blood is bright red in the arteries, dark in the veins, of an average specific gravity of 1.055, of a salt taste, faint odour, an alkaline reaction, and a temperature of 100 Farnteit in the interior of the body, but lower in the extremities and on the surface It holds in suspension large numbers of cells or corpuscles. The fluid itself is called the plasma. The corpuscles are of two kinds—red and white. In a cubic millimetre of normal human blood there are five million red and ten thousand white corpuscles. The red give the color to normal blood; they contain a pigment, hæmoglobin, a complex proteid substance containing about 0.4 percent of iron. The red corpuscles are round dises 1/3200 of an inch in diameter and 1/1200 of an inch thick, and are of a light yellowish tint when seen under the microscope. When freshly-drawn blood is examined under the microscope, the red corpuscles are seen to run together. The form of these red cells may be altered by various diseases ; and another alteration due to disease is the appearance of nucleated forms of different size. The elastic substance of which they consist, called stroma, is a close set spongy structure, and holds the coloring matter. The stroma is held in its place by a pellicle. Their chief function is to act as carriers of oxygen. They absorb large quantities of oxygen in the lungs, and carry and deliver it over to the tissues, even in the most remote parts of the body. The hæmoglobin in the red corpuscles has great affinity to oxygen. When venous blood which is deficient in oxygen circulates through the pulmonary capillaries, the hæmoglobin in the red corpuscles absorb oxygen from the alveoli in the lungs and is held in loose chemical combination. The red corpuscles them carry the oxyhæmoglobin to every tissue in the body where the oxygen is given off through the thin capillary walls for the purpose of oxidation. Their origin is chiefly from the marrow of the bone and from the tissue of the spleen The white corpuscless of the blood are minute, grayish, semi-transparent contractile bodies. They have no cell-wall and their sustance consists of protoplasm. They possess one or two nuclei. They are rich in a protein and the large propostionate quantity of phosphorus in the cells depends mainly on this substance and on lecithin. Their number increases after a meal and is propostionately larger in the pregnant, the newly-born; and in those suffering from certain diseases They exhibit spontaneous changes like amœbac, and hence their movements are termed amœboid. They are less numerous than the red ones, in spite of their important functions. They are derived from lymph corpuscles, the cells of lymphatic glands, spleen and pancreas some of them devour bacteria, dead or degenerate tissue, the products of inflammation, &c and so have been called 'blood scavengers.' But they not only destroy what is effete; their normal secretions, especially those of the granular form, have been shewn to be essential to the economy of the body. Other solid elements in the blood are 'blood plates', rouud bodies less than half the diameter of the red corpuscless; they do not, as a rule, contain hæmoglobin, but are rich in phosphates and glycogen, and are supposed to aid in coagulation Gramular bodies also are found in blood; they are small, round and highly refractive; seem to be derived from the white corpuscles, degenerating red cells, and blood plates; and form precipitates in the blood plasma. The plasma is alkaline, yellowish in tint, and contains 90.3 water and 9.7 solids. The serum is a thin, alkaline, albuminous fluid, separated from the blood during coagulation, and found in small quantities as exudation from serous membranes. The serum contains a ferment. It is supposed that when blood is in the body it contains a globulin "fibrinogen," and that when it is shed the fibrinogen molecule is split up in to a globulin which remains in solution, and fibrin ferment. Which does not exist in healthy blood, but it a product of the disintegration of the white corpuscles and blood plates produced when the blood leaves the vessels or comes in contact with foreign matter.

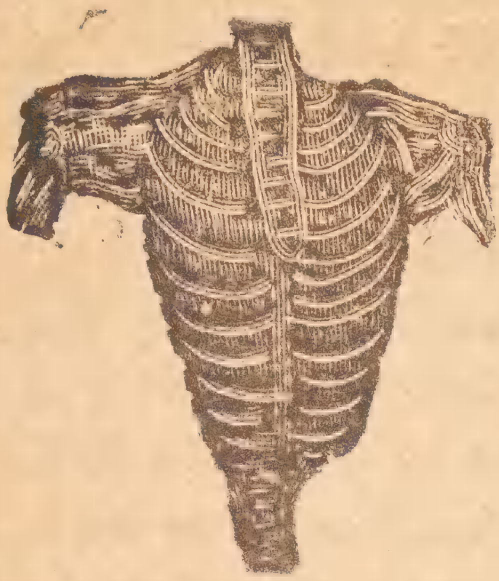
Lymph is a clear, watery, albuminous fluid which bathres all the tissues of the body. It is fanitly yellow or colourless, and is alkaline in reaction. Derived from the blood, it laves and nourishes to the tissue elements, and returns to the circulation by the lmph vessels, bringing such pabulum as the tissues do not require for their nutrition. It is poured in to the large veins near the heart, and in its course through the lymphatic vessels and glands it acquires a number of cells known as lymph corpuscles. During digestion the lymph returned from the villi of the small intestine becomes charged with fattly molecules and extractives from the food. These change its character, giving it a milky appearance, so that the vessels are known as lacteals and the lymph as chyle.

Lymphatics are the superficial and deep vessels and glands which carry lymph throughout the body. The vessels are tubular, and their walls have there thin coats—epithelial, muscular and fibrous. Like veins, they have valves formed of semi-lunar flaps, which direct the out flow of the lymph. The lymph enters the lymphatic capillaries by rootlets arising in the spaces between connective tissue cells, muscular fibres, &c and by minute apertures between the epithelial cells of serous surfaces. There is no direct communication between the capillaries of the blood and those of the lymph, which must, therefore, irrigate intermediate tissues on its way from one set of vessels to the other. From the network of lymphatic capillaries small lymphatic vessels arise which either develop into larger trunks or pass to a lymphatic gland. The thoracic duct is the terminal trunk of the system. The duct conveys the chyle and the greater part of the lymph into the left subclavian vein at its junction with the internal jugular. The lymph from the right side of the head, neck and chest, and from the right arm, is carried by the right lymphatic duct to the right subclavian vein. In the course of the lymphatic or lacteal vessels through the mesentery and thorax and more superficially in the neck, groin, armpit, &c, are numerous glands, generally kidney-shaped, and varying from the size of a hemp seed to that of an almond. In man, the on flow of the lymph is generally enforced by the respiratory movements.

From their powers of absorption, the lymphatics are specially liable to be infected by a poison introduced into the tissues.

Bone is one of the hardest structures of the body and possesses also a certain degree of toughness and elasticity. It serves as the framework or skeleton of the body, supporting the softer structures, forming the joints, and protecting the viscera. It is composed of earthy and animal matter in the propostion of 67 per cent of the former and 33 per cent of the latter. Of the earthy matter 56 per cent is calcium phosphate, the rest beings calcium carbonate, magnesium phosphate and calcium fluoride. The organic substance is chiefly collagen—a substance which is converted into gelatine by boiling. A scetion of bone is seen to be composed of two kinds cf tissue—one external, hard like ivory, a compact and dense tissue ; the other internal, a spongy or cancellous tissue resembling a lattice—work. The shaft of a long bone consists of compact bone surrounding a central canal or medullary cavity, so called from its containing the medulla or marrow. Bones are enclosed in a fibrous membrane, the periosteum, by means of which many of the blood vessels reach the hard tissue. When the periosteum is stripped from the surface of a living bone, the small bleeding points which are seen mark the entrance of the periosteal vessels; the long bones are supplied also by a nutrient artery which enters at the nutrient foramen in the shaft, reaches the medullary cavity, and breaks up into branches, from which small vessels are distributed to the interior of the bone for the supply of the marrow. Veins emerge from the long bones in various places. A section of bone, when examined with a lens of low power, is seen to be divided into number of circular areas, each of which consists of a central hole surrounded by a number of concentric rings. These canals are called Haversian systems. The central hole is a Haversian canal. The average diameter of the Haversian canals is one five-hundredth of an inch ; they contain blood vessels ; and the minute canalculi and lacunæ contain the lymph which is exuded from the blood vessels to the substance of the bone which they traverse. The lacunæ are occupied by branched cells, called bone cells or bone corpuscles, each of which is a little mass of protoplasm, and serves for the nutrition of the bone immediately surrounding it. One lacunar corpuscle communicates with another, with its surrounding area, and with the blood vessels of the canals, by means of the minute streams of nutrient lymph which occupy the canalculi. Bone serves as levers on which muscles act to produce movement. It grows in girth by the deposition of layers under the periosteum, like successive rings under the bark of a growing tree.

Twelve pairs of slender, curved bones, called the ribs, are connected with twelve of the upper vertebræ of the spinal column ; these ribs sweep round to the front of the body, where ten pairs are joined to a bone (sternum) of



6 to 8 inches, shaped like a short sword, by strong pieces of gristle or cartilege. The framework of the hips is made by the hip bones, which join the base of the vertebral column; and on to the hips—bones the legs are attached. The bones in the legs and arms are arranged on the same plan, with one long narow bone in the upper part, small irregular bones at wrist and foot, and small long bones in fingers and toes.

JOINTS.

A Joint is formed by the approximation of two or more bones which are bound together and enveloped by other structures. A distinction must be drawn between rigid and mobile articulations. A good example of the former is the suturas of the cranial bones, whose serrated edges intelock with only a thin sutural membrane between. When adjacent bones are separated by a plate of cartilege which is adharent tc each, a limited amount of mobility results, and such a joint is known as a mixed articulation; the joints between the vertebræ are of this type while the movement possible at each joint is but slight, the spine as a whole acquires a considerable degree of flexibility from a series of such articulations. Some jonts are freely movable.

That part of each bone which enters into the formation of such a joint is covered by a thin layer of cartilege, which acts as a smooth bearing surface over which the other moves with little friction. A joint of this nature is also provided with fibrous ligaments, which by binding the bones together limit the range of movement, and with a synovial capsule or sac, the inner surface of which secretes a glairy lubricating fluid known as the *Synovia*. The outer layers of the synovial capsule are dense and fibrous, and the whole forms a bag enclosing the joint cavity into which the articular surfaces protrude. In the knee and maxillary joints are inter-articular pads of cartilege, which, besides giving greater elasticity, allow of more complicated movements. Freely movable or perfect joints may be hinge-shaped; or of the ball-and-socket form; or, again, the movement may be either gliding or rotatory. In the hing-joint, the opposing surfaces of the bones have elevations and depressions which fit into one onother and allow of movements only in one direction, *i. e.*, a backword and a forward motion in one plane. The elbow, ankle and knee joints are of this type. The ball-and-socket joint gives the widest range of movement, as in the shoulder, to which the ball-shaped head of the humerus is applied to the shallow socket of the scapula. The hip joint is also similar. Dislocations and fractures of joints are the commonest affections.

The above details will impress how wonderful and beautiful is the mechanism of our body, and how careful we ought to be to keep its delicate machinery in good working order. For unless this is the case, even if only one part of our human machine becomes out of gear and refuses to do its work properly, the whole of the body is interfered with, and we speak of ourselves as being ill We have a great many organs or parts, each of which performs a special kind of work in the body, and if anything goes wrong with any one of these parts, we can no longer enjoy life and do our work easily and without pain. The body is far more intricate in its structure than a watch. It is also not easy to get the body back into a state of health after it has been disturbed. We have therefore to be very careful about our bodies in all ways, and do nothing which would tend to upset its proper working.

The body is a kind of co-operative arrangement, in that all its parts in health work together and labour in harmony for the good of the whole frame. Each part or organ has its own work to do, and does it, and this is "division of labour." The heart has to do its work in circulating or pumphing the blood all through the body to nourish it. The lungs have to do their own share of the labour inpurifying the blood, and in taking in air, containing oxygen gas, which is part of our food, and passes into the blood as does all our other foods. The digestive organs have their work to do of digesting food and fitting it to be added to the blood, while the brain and other parts of the nervous system govern and rule the body. It will thus be seen that while the body is that of a single being, it is really a kind of compound or co-operative thing made up of ever so many different parts, each doing its own work, aud thus making up a part of what we may call a complete and harmonious whole.

The generative organs are appropriately treated in Part II.

CHAPTER V.

There are agents in nature which have a friendship for, and an affinity to, the vital power, and which are capable of exciting, invigorating, and in great probability, of affording it a suitable nourishment. These in particular are light, heat, air or rather oxygen and water : four celestial gifts, which with great propriety may be called the friends and guardian spirits of life.

Light is, without doubt, the most intimate friend and relation of life ; and in this respect has certainly a much more essential effect than is commanly believed. The life of every created being is the more perfect the more it enjoys the influence of light. A plant or an animal deprived of light, notwith-standing every nourishment, care, and cultivation, will first lose its color, then its strength, and at last entirely decay. Every man who passes his life in darkness becomes pale, relaxed, and heavy, and at length loses the whole energy of life. It is not too much to assert that organised life is possible only under the influence of light, and in all probability through it ; for in the bowels of the earth, in the deepest caverus, where eternal night prevails, nothing is seen but what we call unorganised life.

Heat, the no less beneficent friend of the vital power, is alone able to call forth the first movements of life. When winter has reduced all nature to a death-like condition, the genial warmth of the spring atmosphere only breathes upon it, and all its dormant powers are awakened to activity. The nearer we approach the poles everything becomes more dead, and at length are found districts where absolutely no plant, insect, or small animal can exist, and where only large masses of being, such as whales, bears, and the like, can retain their warmth necessary for life. In a word, where there is life there is heat, in a greater or less degree; and between both there is a very important and inseparable connection. Warmth gives life, and life again excites warmth, and it seems difficult to determine which is the cause, and which the effect. Warmth, in cases of apparent death, acts evidently with as much power as on the first expansion of life; it nourishes the smallest sparks of the vital principal still remaining, fans them, and gradully rouses them into flame.

The third important nourisher of life is *air*. No being can live without air, and sudden, sometimes istantaneous, death is to most of them the consequence of its being with drawn. What makes its influence highly visible is, that those animals which breathe are more abundant in the vital power, and posses it in greater perfection than those which do not breathe. Vital air appears, principally to be that component part of the atmosphere which affords the strongest and best nourishment to the vittal power. The grand principle of this vital air is known to be oxygen which in the air contains life, and passes into the blood by breathing. It is not only an essential in the structure of all living things but forms a large part of the air and water which are essential to their continued existence. It is also a constituent of every mineral and rock, and is estimated to form about 47 per cent of the whole mass of the globe. The enjoyment of pure air is a nourishment equally necessary for our existence as eating and drinking, and it is the greatest means of strengthening and supporting life. One of the greatest means of shortening life is, men living together in great cities. Dreadful is the preponderence which the ravage then occasioned has in the bills of mortality. They are open sepulchres of mankind. The death rafe is not so high in the country as in cities. The moisture or the thickness of the air is not what alone makes it prejudicial, but the animalisation which it acquires by so many people being crowded together. We can at most breathe the same air only four times, for it is then, from the finest support of life, converted by our-selves into the most deadly poison. We may now reflect on the at mosphere of such monstrous places, where it is impossible for an inhabitant to inspire a mouthful of air that has not been for some time already in the lungs of another. This produces a general secret poisoning, which, upon the whole, must necessarily shuten the duration of life. At least one should endeavour to quite the city atmosphere for an hour or half an hour everv day in order that he may inspire a little fresh air.

Those who keep their sitting apartments or bedchambers always closely shut expose themselves to a slow poisoning of the like kind. In the same manner may the air be poisoned when a great many lights are kept burning in a close room. And the case is the same when one sleep in a close bedchamber where coals are burning, by which death is often the consequence. Similar will be the effect when one keeps in a close bedchamber during night a great many plants and shrubs. Evaporation from putrid substances and the strong-smelling of flowers in close apartments are capable of producing pernicius results. The air in which one lives should be kept in a moderate degree of temperature say, 66 degrees Fahrenheit, as heat of a higher tempe-rature accelerates in an extra-ordinary degree the stream of vital consumption.

Water, a compound, is as essential for building up living organisms as is carbon, and its more obvious qualities are singularly unlike those of its components, oxygen and hydrogen ; oxygen supports combustion, water cheks or destroys it ; hydrogen burns readily, water is incombustible. Water is wonderfully stable at ordinary temperatures, hence it is the most innocuous of fluids ; it is also an almost universal solvent, hence its great value in cookery, in the arts, and for cleaning purposes. Besides being absolutely essential for vegetable and animal life it has qualities which render it serviceable to civilised man, both in his pleasures.

A little digression may be interesting and excusable and his scientific discoveries. Absolutely pure water is non-conductor of electricity ; but as all natural waters contain gases or salts in solution, it then becomes a conductor, and is partly decomposed, or becomes an electrolyte. One of the facts that seem to be now generally accepted is, that water is not the simple compound, H_2O, it is usually held to be, but is really a compound of three hydrols, H_2O being gaseous water, $(H_2O)_3$ being ice, while liquid water is a mixture of these or $(H_2O)_2$.

The strange chemical properties of water are probably the cause of the singular but most important fact that water reaches its greatest density at 4 degrees centigrade (about 7 degrees Fahrenheit) above the freezing point. If this curious anomaly did not exist the coldest water would always be at the botton, and would freeze there ; and thus many lakes and rivers during a hard winter would become solid ice, which the succeeding summer might not be able to melt.

There remain yet some further relations of water to life which may be here briefly noticed. Among the various agencies that have modelled and remodelled the earthis surface, water has played the most important part. It is to water that we owe its infinite variety, its grandeur, its picturesqueness, its adaptability to a highly varied vegetable and animal life ; and this work has been carried out through its manifold physical and chemical properties. It is in its three states, solid, liquid and gaseous, that water exerts its most continuous and effective powers ; and it is enabled to do this becuase, though each of each of these has its own limited range of temperature, they yet overlap, as it were, and can therefore act in unison. Thus within the narrow limits of temperature adapted to organic life we have both ice and water-vapour, as well as liquid water, in almost continuous action. Through dew mist and rain, water penetrates every fissure of the rocks ; through the carbonic acid gas dissolved in it, the rocks are slowly decomposed ; by the expension of water between 39 and 32 degrees Farnheit, it freezes in the upper parts of the fissures, and when the temperature continues to fall the further expansion during ice crystalli-sation forces the rocks asunder. The most massive rocks at high altitudes are first cracked and fissured by expansion and contraction due to alternations of temperature caused by sunheat, then decomposed by rain, then fractured by the irresistable force of ice - formation. On a large scale inpolar regious, and everywhere at great latitudes, snowfields and permanent glaciers are formed, which not only carry down uncomman quantaties of debris on their surfaces or embadded in their sustance, but with the help of that which is carried along the valley-floors they rest on, and by the enourmous weight of the ice itself often miles in thickness, grind out deep valleys and ice - basins before cosmic or other agencies cause them to melt away. This continuous wateraction goes on perpetually in every continent, and is the great agent in producing that infinite variety in the counter of the land surface—level plains, gentle slopes, beautifully rounded downs, wave-like nudulations, &c, in endless variety, beauty, and grandeur. All this we owe to what are termed the "properties of water," that extremely simple and unappreciated element, which still abounds in mysteries that puzzle the men of science. Without water in all its various forms and with its many useful but very familiar properties, not only would life on the earth be impossible, but unless it had existed in the vast profersion of our ocean depths, and been endowed with its less familiar powers and forces, the whole world instread of being a constantly varying scene of beauty—a very garden of delights for the delectation of all the higher faculties of man,—would have been for the most part a scene of horror, perhaps the sport of volconic agencies of disruption and up heaval only modified by the disintegrating effects of sun and wind action.

Water belongs to the class of agents friendly to life, so far as it contains oxygen; and it certainly promotes life, for without fluidity no expansion of life is possible. It is best drink, but it is a great point that it must be fresh, that is, recently drawn from a spring or running stream, and be put into a vessel well stopped; for all spring water, like the numeral, contains fixed air, which renders it strengthening and favorable to digestion. Pure, fresh water has certain adventages which must certainly in spire us with respect for it. The element of water is the greatest and only promoter of digestion. By its coldness and fixed air it is an excellent strengthener and reviver of the stomach and nerves. On account of its abundance of fixed air, and the saline particles it contains, it as a powerful preventative of bile and portrefaction. It assists all the secretions of the body.

Without water there could be no excretion. As oxygen is a component part of it, by drinking water one actually imbibses a new stimulus of life. Wine rejoices the heart of man, but it is by no means necessary for long life. Nay, as a stimulant which accelerates vital cousumption it may tend very much to shorten life, when used too freguently, or in too great abundance. Impure water may be renderd sweet by charcoal-powder. Take some burn charcoal and reduce it to a fine powder ; mix a spoonful of the powder to a pint of water stin it well round and suffer it to stand for a few minutes. All the water to run through filtering paper into a glass, and it will be found quite transparent, without any bad taste or smell, and perfectly pure for drinking. Charcoal powder may be preserved for a long time in a small bottle well corked and carried even in travelling.

The action of *carbon*, which forms the basis of organised life and matter is another interesting study similar to that of water. It is perhaps the most unique, in its physical and chemical properties, of the whole series of the elements, and it seems to exist for the one purpose of rendering the development of organised life a possibility. It further appears that its unique chemical properties, in combination with those of the other elements which constitute protoplasm, have enabled the various forms of life to produce that almost infinite variety of substances adapted for man's use and enjoyment, and especially to serve the purposes of his ever-advancing research into the secrets of the universe.

It is universally admitted that carbon is the one element essential to all terrestrial life. Although it is so familiar to us in its solid form as charcoal, or in a more mineralised form as block-lead or graphite, it is doubtful whether it exists uncombined on the earth except as a product of vegetation. It exists as a constituent of our atmosphere, of which carbon-dioxide forms about 1/2500th part, equal to 1/7000th part by weight of solid carbon; and it is from this that the whole of the vegetable kingdom is built up. The leaves of plants contain a green substance named chlorophyll, which by the aid of sunlight can extract the carboon from the gas. The chemist has to use the electric spark, or very high temperatures, to perform what is done by the green leaves at the ordinary temparatures in which we live.

Carbon unites chemically with almost all the other elements, either directly or by the intervention of some of the gases. It also possesses the foundamental and distinctive quality, in a much higher degree than any of the others, of uniting with itself to form complicated compounds, containing an aggregation of carbon - atoms united with either oxygen, hyodrogen, nitrogen, or several of these, bound together to form a distinct chemical whole.

Carbon is also the one element that is never absent from any part or product of the vegetable or animal kingdoms; and its more special property is that, when combined with hydrogen, nitrogen, and oxygen, together with a small quantity (about 1 per cent) of sulpher, it forms the whole group of substances called albuminoids (of which white of egg is the type,) and which, much diluted, forms the essentiel part of the blood, from which all the solids and fluids of organisms are secreted.

But besides the carbon in the atmosphere an immense quantity exists in the various limestone rocks, consisting of carbonate of lime. It is quite possible that these are all results of animal secretions, or of the debris of the hard parts of marine animals. All water holds in solution a large quantity of carbonic acid gas, so that both air and water are the source of the most essential elements for building up the bodies of plants and animals The ocean also holds a large amount of carbonate of lime in solution, and this is kept permanently dissolved by the large amount of carbonic acid gas always present, which is sufficient to disssolve five times the amount of carbonate of lime which actually exists.

The occurrence of all such elements in tolerable abundance, and the existence of a few elements which, when specially combined, produce glass, a substance without which modern science in almost all its branches would have been imposible, we are brought face to face with a body of facts which are wholly unintelligible on any other theory than that the earth was constituted as it is in order to supply us, when the proper time came, with the means of exploring and studying the inner mechanism of the word in which we live—of enabling us to appreciate its overwhelming complexity, and thus to form a more adequate conseption of its author, and of its ultimate cause aud purpose

CHAPTER VI.

FOOD.

Food is an absolute necessity to keep up our strengh. Every day our bodies are being subjected to the wear and tear of the machinery of which they are made. Every breath we draw, every muscle we exert, our very heart beats even, serve to wear away some of our strength ; but, happily, just as a machine can be kept in good repair, so can the wearing away of the strength of our bodies be made good by means of the food ard drink we take at meal-time.

Food is divided into four groups:—1. The aqueous, 2. the saccharine, 3. the albuminous, and 4. the oleaginous. In the first, we have water, tea, coffee, &c. In these cond, such articles as sugar sweet, fruit, arrowroot, sago. In the third are comprehended fish, flesh, fowl, cheese. Lastly, the oil groups is represented by butter, animal fats, &c The reason why we require so many different kinds is that different foods serve to nourish different parts of our bodies. Some serve to strengthen the muscles, others are very good for the blood, and others serve to build up bones. No one can be well and strong who has poor blood or weak bones and muscles, and it is therefore necessary that we take food which repair the wast of all these.

But as food is repuired not only for building up of our body but also tokeep it in proper working order, it is divided into two main classes—body-building foods and working foods.

The foods which build up the body are water, minerals, and certain substances called nitrogenous foods or proteids.

A man's body is made up of one-third of solids and two-thirds of water. Water comes into the composition of every part of our frame. It is found equally in brain and bone, and it makes up the largest part of the blood. It is always used up in the body and is given off from skin and lungs and kidneys and this is why we cannot live long without water. It is, besides, needed for the digestion of our food, and for many other uses and actions in the body.

Of minerals we require phosphate of lime, salt, iron, sod and potash. Phosphate of lime is used in building our bones : when infants do not get enough of it, they grow up with deforeced bodies. Salt is required 'for the digestion of food in the stomach and also for the blood. It is also given off in many fluids—sweat and tears-of the body. Iron is required to give to the blood its red color and for making the blood-globules do their work. If enough of potash is not taken in, one will be liable to the disease known as scur. The minerals we need we mostly get along with other foods, such as vegetables, meat, bread, rice. When enough iron is not present in the blood, the person looks pale or ænamic and the doctor prescribes him iron in the form of a medicine.

The nitrogenous foods are albumen, casein, legumin, gluten, gelation, &c and are got from milk, meat, fish, fowel, eggs and vegetables. Albumen is obtained from meats, fish, fowl and eggs ; case in from milk; legumin from peas, beans and lentils ; gluten from flour ; and gelation from bones. These foods may contain other things, such as fat, starch, &c. Gelation is not such a body-building food as the others. This species of food from the basis of all our living matter, and form blood in part, muscle and the living matter of bone, brain, and all other organs They are the great means by which our body substance is not merely literally made, but through which it is always being repaired to make up for the loss of the substance which our body's work causes.

The human bodies get their power of doing work from two classes of foods—fats and starches and sugar. Starch and sugar are very much alike; all the starch we eat contained in bread, rice, potatoes, &c, has to be turned in to sugar before it can be used in the body. These being burned in the body by a chemical action give the muscles and other parts the power of doing work. These foods are also heat producers; they give to rise to heat in the body, and heat is transformed in the muscles in to working power, the excess of heat being given off from the body as part of our waste.

Fat is the most powerful heat producer. Starch and sugar are also valuable working foods, and probably we defend for our power mostly npon them.

We want every day for more working food than we do body-building food to repair our waste. It the food taken in the day be summed up, it will be found that the food taken ia about four and a half parts of starches and sugars to one part of the body-building foods.

Our diet depends a great deal upon the place—climate, we live in The colder the climate, the more animal and fat men require; and the warmer the climate, the more fruit and vegetables they require In temperate climates a mixed diet is taken. This will be found to be the great law of life that people tend to become fruit and vegetable eaters where these foods grow plentifulls, but where these are not plentiful, people will consume more meat. In hot weather people require a light diet, whereas in winter they eat more more meat and fat, simply because the fat is especially required as a heat producing food.

Though it is an advantage peculiar to man that he can digest and assimilate the most heterogeneous kind of nourishment, it is found by experience that those who were not to nice or particular in regard to their food, but who lived sparingly attained to the greatest age. The greater part of mankind eat more than is necessary and by being crammed and over-fed in infancy are deprived of that natural sensation which ought to tell them when they have enough. The cause of all the complicated maladies of the human race is their gormandising and stuffing, and stimulating their digestive organs to an excess, thereby producing nervous disorders and irritation. He who wishes to live long ought to eat slowly. Moderation in eating and drinking is the golden mean. In the choice of food one should incline more to vegetables. Flesh has always a greater tendancy to putrefaction; and vegetables, on the other hand, to acidity, which corrects putrefaction, our continual and greatest enemy. Besides, animal food is of a more heating and stimulating nature, whereas vegetables produce cool, mild blood, lesson the internal motion, mental as well as bodily irritability, and powerfully retard vital consumption. Lastly, animal food yields more blood and nourishment. and requires, in order to be beneficial, much more labour and bodily motion; and by the use of it one also is liable to become plethoric. On this account it is not proper for men of letters, and those who sit a great

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deal, as such people do not repuire so strong restoration› or so much addition of substance, but only of those fine nourishing juices that are necessary for the spiritual functions. One, above all, ought to avoid flesh in summer, and when putrid fevers are prevalent. It is not those who lived on flesh, but on vegetables, fruit, and milk, who attained to the greatest age. Milk is by consensus of opinion taken as the type of human food. The general and correct idea of the composition of that invaluable article is:—

Components.	One pound contains.					
	Human Milk.		Cow's Milk		Asses' Milk.	
	ozs.	grs.	ozs.	grs.	ozs.	grs.
1. Water	14	41	13	333	14	76
2. Sugar	0	280	0	315	0	420
3. Caseine	0	210	0	350	0	140
4. Buttor	0	210	0	245	0	105

Besides the above, each contains a small propotion of mineral matters, such as phosphate of lime, potash, and a trace of iron.

The relative composition of the food agent is;—

	Carbon.	Hydrogen.	Oxygen.
Starch consists of	24	20	20
Sugar	24	28	28
Fat	66	10	8
Alcohol	10	24	8

The stomach of a human being is that marvellous chemical laboratory in which every kind of material must be got up for the supply of the wants induced by the wear and tear of that mysterious structure, with its millions of wheels within wheels, the living body. In one of the hidden, dark recesses of this vital alambic, matter must be extracted to build up or renew the brain and spinal cord, with their countless nerves; in another corner, food must be concocted for the ceaseless pumping wark of that hydraulic machine, the heart, with its innumerable arteries, as well as for the voluntary musclcs of the body—450 and upwards in number. The fingers, the delicate eye, and all must be as carefully attended to, and their wants supplied, hour by hour, as any other portion of the frame. But what can we say of that mighty fabric, with its 254 bones ? The same fluid that supplies the eye with a tear, the mouth with saliva, the liver with bile, or the skin with moisture, also hedges up, moment by moment, the gradual decline of this osseous scaffolding. An animal would also in miniature is contained in the blood; and this life-giving, life-maintaining fluid, is wholly derived from the quiet, healthy, and regular elaborations of that chemical closet, the stomach. There we find a substance which turns starch of rice, potato, & c. into sugar; another to deprive meat of its fibrine, a third to extract albumen from fish or oil from fat. Yet the mystery is impenetrable that the gland secreting a fear, has no power to secrete Saliva ; that the liver could no more send out perspiration in lien of bile than it could create itself Each organ has life in itself; and each, 'after its kind,' performs that *role* in the humam economy for which it has been endowed. But the stomach may be styled the paragon of wonders within us." Its whole operation varies from two to five hours according to the quantity and quality of the food taken. If there is no food to dissolve, the coats of the stomach become enfeebled by the presence of the gastric juice, which atlenth deteriorates from its original purity and activity. One of the main causes of disordered stomach, lowness of spirits, and enervation of mind, arises from a very prevalent fashion of huddling three meals into a few hours, whereby the stomach is left fifteen or sixteen hours idle, whilst it has had to accomplish, in seven or eight, the work of eighteen hours. Three meals, at a distance of six hours from each, will always prove the standard by which a valetudinarian, from indigestion, may be guided. Thus, more cases of indigestion may arise from abuse in our daily food than from the quality of the food.

Animal heat in advaneed life is better sustained by starchy than by oily food, the former is readily converted into sugar, and thus becomes a good heating material, whilst fat must be submitted to a more inricate process ere it can enter the systam, and be serviceable to the economy.

CHAPTER VII.

GLUTTONY.

The pleasures of the eye, the ear of and smell are so well-defined by natural function, that is only rarely men abandon themselves to the gratification of the senses—the desires of eating, drinking and the sexual function.

Eating is a necessity for the body. Gluttony or immoderate eating is prejudicial to life in two ways. It overstrains the powers of digestion, and therby weakens them. It prevents digestion, because with such a quantity the whole cannot be propeperly prepared; and crudities in the intestines and bad juices are the consequence. The effect upon the mind is disastrous, the depression of spirits being due to repletion. It increases also proportionably the quantity of the blood, and thereby acelerates circulation and life. Besides, it gives rise to indigestion and the necessity of using vacerants which, always weaken.

The effects of gluttory are-heaviness and fullness of the stomach, yawning, eructation, drowsiness and confusion in the head. The old rule-give over eating while you have still some apetite left-contains much truth.

Too refined cookery, belonging to the same class, is one of the greatest enemies of life, being one of the most destructive inventions for shortaning it The principal part of this art is to make everything piquant and stimulating. Every article of food is half composed according to this preparation of hot, stimulating substances, and instead of accomplishing by eating, what is the natural object of it, nourishment and restoration, the centrary thereof, internal consumption is produced by irritation. Taking a meal of this kind is consuming oneself. In adopting such a course, the person fails to make a distinction between the appetite of the palate and that of the stomach, does not heed to the remoustrance of the stomach, and causes the stomach labour thrice or four times as much as it is capable of performing. He thereby loses, at length, one of the greatest supports of life, the property of knowing when he has had enough. Again, by combination, things which singly and alone were perfectly harmless and innocent, become altogether new and destructive.

Hence, it must be laid down as a fundamental principle, that the more compounded any kind of food is, the more difficult it will be of digestion, and what is still worse, the more corrupt will be the juices which are prepared from it. It has also been imagined that it is a grand acquisition to bring nourishing juices into the body in the most concentrated from, without exposing the teeth to the trouble of chewing, or the stomach to the labour of digesting. But it is the favourite system of those who consume themselves in that manner. With reason it has been made a low that the stomach can receive only a certain quantity; a degree more would be too much for the whole. The consequance is a continual pathora of all the vessels, entailing the destruction of the equilibirum as well as the health, and in the end life itself.

It has been further established by nature, on good grounds, that man should use his nourishment in a form rather coarse. Its advantage is that the food is first chewed in the mouth. mascerated and mixed with saliva; next, longer retained in the stomach, in order, by its stimulating quality, to incite the stomach to more reaction, consequently much better assimilated and changed into the nature of our substance. For, nourishment can pass in to our bodies, and become truly useful to us, only after it has been, by the powers of the stomach, rendered homogeneous and similar to our sustance. By transgressing this principle, one creates in the body juices, which because they have not been sufficiently aggimilated, are unable to effect proper restoration; but which, as foreign particles, tend to irritate, and promote consumption, much more than restoration. It would appear that the said art was invented to convert one of the noblest gifts of God into a secret poison. Thus eating can only be regulated or modified, and does not allow that latitude of self-control which it would admit of if the life of the body could be sustained without it.

CHAPTER VIII

DRINKING.

Drinking too much is on a par with gluttony and even worse. It is a most dangerous habit, and sometimes seems to be beyond cure, when alcoholic liquors have become the objects of a settled habit Preparations of spirituous liquors, under whatever name known tend in a particular manner (as a stimulant) to shorten life, by accelerating vital consumption in a dredful manner. To drink them is to drink liquid fire. Except in cases of sickness, the good of alcoholic liquors is more than overbalanced by the danger of acuiring a taste for it. Total abstinence is often cheaper than moderate consumption, followed by a desperate struggle not to become a victim of spirits. An ounce of prevention is worth a pound of cure, and it is wiser to abstain oneself than by example to lead a weak brother into temptation Wine rejoices the heart of man and those who never drank it seem to have become oldest.

CHAPTER IX

SLEEP.

Sleep is a natural condition of insensability, more or less complete, recurring normally for the adult with each night, and losting for from six to eight or nine hours. The infant may sleep twenty hours out of each twenty-four ; the growing child night take twelve hours at a stretch. After middle age sleep tends to become lighter i. e., more easily broken, and of shorter duration The cause of sleep is undetermined, but is supposed to depend upon the production of sedative agents during our waking activities, which ultimately clog the higher functions of the brain. It is believed that the brain is comparatively bloodless during normal healthy sleep. Sleep of a sort may, however, occur with a considerably congested brain, as under the effects of alcohal. The necessary amount of sleep varies greatly with the individual, and also with the occupation of the waking hours. Mannual occupation out † of † doors is amongst the surest producers of sleep ; but overfatigue, whether bodily or mental, may produce broken sleep or frequent dreams. The healthy individual sleeps deeply for the first two hours or so ; then the sleep becomes lighter for a while, and then heavier again. The ideal sleep, though comparatively rare, is dreamless. Sleep is a physiological necessity, and the average individual suffers considerably after forty-eight hours of absolute sleeplessness. In natural deep sleep all the higher brain-centres are more or less out of action, together with the senses of sight, touch· taste, smell and hearing, though in varying degrees. The vital functions are lowered ; respiration and the heart's action are slower. More oxygen is inspired, less carbon dioxide is expired. It is suggested that in this way those products of activity which have produced sleep become oxygenated, and waking is the result. Sleeplessness, besides being caused by cerebral stimulants, such as tea, coffee, and cocoa, accompanies rise of temperature, frequently precedes delirium tremens, may be caused by small doses of opium, and occurs in the opium-eater when the usual dose is denied.

The time of sleep is nothing else than a suspension of intensive life, or an apparent loss of it; but even in this suspension or interruption of its activity, lies one of the greatest means of preserving it. Sleep then comes to the relief of the body, reduces it to a more passive condition, and after a pause of six to eight hours, the destructive stream of vital consumption is so much checked; what has been lost is so fully renewed that pulsation and all its other movements are again performed regularly. Old sleep sleepless because their intensive life or vital consumption is weaker, and requires less restoration. Nothing, therefore, is able to waste and destroy us speedily as long-continued want of sleep. It will now be seen that sleep is one of the wisest regulations of nature to check and moderate, at fixed periods, incessant and impetuous stream of vital consumption. "Take from man hope and sleep, and he will be the most wretched being on earth" is a pregnant saying. Sufficient sleep is necessary not only for intensive life, but also for extensive, in regard to its support and duration. Nothing wastes us so much before the time and renders us old, as a want of it. The physical effects of sleep are that it retards all the vital movements, collects the vital power, and restores what has been lost in the course of the day, and that it seperates from us what is useless and pernicious. It is, as it were, a daily crisis, during which all secretions are performed in the greatest trauquility and with the utmost precaution. Continued watching unites, all the properties destructive of life, incessant wasting of the vital power and of the organs, acceleration of consumption, and prevention of restoration. It accumulates too great an abundance of pernicious juices, makes the organs too flaccid and unfit for use, and in this manner can shorten life also.

To enjoy sound peaceful repose, and obtain the whole end of sleep (*a*) the place where one sleeps must be quiet and obscure. The action of external impressions are likely to disturb the soul's rest.

(*b*) the said place should contain pure sound air and therefore roomy and high, with windows always kept open.

(*c*) the person should eat little and cold food for supper and invariably a few hours before going to bed.

(*d*) in bed he should not lie in a forced or constrained posture, but always horizontal, the head a little raised.

(*e*) he should then free himself of all the cares and burthen of the day. No practice is more destructive than that of studying in bed, and of reading till one falls asleep.

(*f*) the unity of our natural chronology requires not to substitute the sleep during the day to the sleep during the night. All men every night have a criticial perspiration, more perceptible in some and less so in others, by which whatever useless or pernicious particles have been imbibed by their bodies, or created in them, during the day, are secreted and removed. The neglect of this principle results in the bodies not being completely purified, and in infirmities, rheumatic pains and swollen feet. Those who spend the night in labour, and the morning in sleep loose that time whibh is the most beautiful and best fitted for labour. At night our bodies are drier and more exhausted, while in the morning we have more pliability, powers and juices —the characterestics of youth. In the morning all nature appears freshest and most engaging; the mind is also clearest and possesses most strength and energy. It is not,as it night worn out, and rendered unequal, by the multifarious, impressions of the day. by business and fatigue; it is then more original and possesses its natural powers. This is the period of new mental creation, of clear conceptions, and exalted ideas. He who neglects this period neglects the youth of his life. All those who attaind to a great old age were fond of early rising.

PART II.

CHAPTER I.

INTRODUCTION.

It is only by culture that man is in the way to perfection. If he is desirous of enjoying the pre-eminence of human nature, his spiritual as well as his physical powers must obtain a certain degree of expansion refinement and exaltation In a rude and uncultivated state he is not a man; he is only a savage animal, who has certain dispositions which fit him for for becoming a man; but as long as these dispositions are not expanded by culture, he is raised, neither physically nor morally, above the other classes of animals in the like situation. The essential part of man which he possesses is his susceptibility of perfection; and his whole organization is so ordered that he may either become nothing or everything.

The influence, therefore, which culture has in bringing to perfection the physical man, as well in prolonging his life, his highly worthy of attention. Both hyperculture, which makes man too delicate and refined, and want of cultivation, when the faculities are not, or have been too little, expanded, are extremes. On the other hand, a proper and suitable degree of mental and bodily culture, and in particular, an harmonic formation of all these powers is absolutely requiste before man can attain to that pre eminence over animals in his physical state and vital duration of which he is really susceptible.

Real culture expands the organs to perfection, and consequently renders life richer as well as fuller of enjoyment; and occatians more abundant restoration It renders the whole texture of the boby somewhat softer and tenderer; consequently lessons that too great hardness which impedes duration of life. It secures us against those destructive and life-shortening causes which deprive many savages to their existance; such as cold, heat, in the fluence of the weather, hunger, poisonous and purnicious, subtances, & c. By reason and moral formation it moderates and regulates the passionate and merely animal part in man; teaches us to supports misfortunes, injuires and the like; and by these means moderates, the too violent, and active consumption, which would soon destroy us. It makes us acquainted with a multitude of conveniences and means for rendering life more agreeable, which are less necessary in youth, but which are of the utmost importance in old age. It will now appear what degree and what kind of culture are necessary those which physically, as well as morally, have for their object the highest possible formation of our powers, but which are always regulated by that supreme moral law to which everything to be good, suited to its end, and really beneficial, must have a relation. Such a culture is all the more necessary in as much as the love of life is interwoven with our frame in so wise and intimate a manner that even with those who are deprived of its comforts and enjoyments, those who suffer from incurable diseases or bewail the loss of freedom in the gloom of a dungeon, the idea of living and existing presents some charms and it will require a derangement of the finest organs of sensation, a circumstance possible only in man, a total darkening and deadening of the mental faculties, so render life to us either disgusting or indifferent.

The main characterestic on the new present-day civilisation, affected by the vast advances in scientific research, which has wonderfully hastened human devolopment, is specialism, and race, nation and class distinctions have bugun to crumble, leaving each man "equal, unclassed, tribeless and nationless, exempt from awe, worship and degree, rhe king over himself, just, gentle, wise." The momentous choice of professions which came to man after he had finished his college education, in the days when there existed only a single course in arts, now faces the boy before he enters college. He must decide what course he will elect, to fit him for his future career, before he has become a youth, and has begun his higher education. The most wonderful genius can only hope to be great in some one single field, or more often; in some part of it. From being means of livelihood, every field of activity becomes a profession, a calling, demanding the devotion and skill of the whole life. Even to-day the man without a trade or function in the social organism is at any moment liable to starve; much more so will he be in the future, when years of training will be requisite to fit a man for the most humble avocation.

The development of knowledge and skill appears to have by magical means increased the value of each life to itself and to others, until the value of the whole had become multiplied almost indefinitely. But careful considearation will shew that the gain is not so great as it appeared. The law of conservation of energy obtains in such a manner as that even if every part of the life is made more useful and available, yet the sum of the life-force ramains the same.

What is gained in intensity is lost in extension. The deeper the river becomes, the more the banks approach. Concenration of attention on one narrow field loosens the mental grasp of the interrelation of everything else, even in spite of popular intsruction in other departments of knowledge. In the midst of the confusing number of sciences & c, men lose sight, or rather, are in danger of losing sight, of the art of conducting the whole life harmoniously. The things that are, in the long run, least important, take up most of a mans' time; and the most vital things, truth, honesty, virtue and purity, become dim, vague and hypothetical. The career of man at present is likely to make more progress in the art of shortening life than in that of prolonging it.

The conduct of life consists in preserving the due proportion between the interest of the present moment and that of the future destiny, parmomising the part with the whole Earthly avpcations are after all not ends in themselves; they are but the means by which men be come perfected and worthy of their divine interitance. Things are good or bad only according to their utility, and therefore should be followed as for as useful, and not for themselves. The art of life or conduct demands the skill to adjust all functions of the organism and activities of mind and body in order to produce the results most advantageous on the whole. He should embrace every suitable opportunity and undertake nothing without sufficient reason. This careful self-scrutiny and self-direction is conduct, intelligent and planned, not emotional and fortuitous.

Again, such a course of life as not easy, however. The least acquaintance with the world reveals the multiphlicity of the kinds of lives that may be led, and ideals that may be struggled after. To be wise in making selection of these possibilities, and to have determination to retain hold on them, demands the utmost skill and ressource. It would be superfluous to enumerate the various kinds of lives and ideals which the memberless functions of the social organism give rise to. They are, after all, **secondary** to the conduct of the bodily functions of the acting subject, which ultimately determine succes or failure. The guidance of these natural functions, few as they are in member, are perplexing enough to warrant the devotion of a man's whole intelligence in directing them. It should be remembered that the length of life does not consist in the number of days but in the use and enjoyment of it, i. e., in applying it in such a manner as to ennoble human nature and raise it to perfection.

It is remarkably regrettable that subjects of such vital importance should have been so little studied or attended to. Most men and women are wholly ignorant of that which furnishes the crude vitality which is the basis of their lives. False modesty leads to ignorance, and ignorance leads to bad health, and lax standards of morals in respect to the most important function of the body. It well be the glory of the present period that men will learn to direct their vitality as intelligently as they feed and train their muscles and their digestive and secretive function. Then it will be possible for men to economize their vitality, and by control of their lower selves by the higher self, to use what nither to ministered to their self-gratification for the higher purposes of attaining the highest possible state of physical and psychical health, that they may live wholly in accord with all natural law.

CHAPTER II.

THE MALE REPRODUCTIVE ORGANS.

The male reproductive organs are partly contained within the pelvis, and partly suspended between the thighs; this group including the ***penis*** and the *scrotum*, containing the ***testes***, are hence called *external organs.* ***Pubic*** is the external region of the organs of generation which after puberty is covered with hair. The penis is attached to the pelvic bones by suspensory ligament. The *glans* or *glans penis* is the head or extremity of the penis naturally covered by the foreskin. The *froenum* is the band of fibrous and mucous tissue attaching the prepuse or foreskin to the "head" or gland of the penis. The *urethra* is the channel of the penis. Below the root of the penis hangs the bag of integment, the *scrotum*; its cavity is double, and each compartment contains the *testis* or *testicle* of that side. The outer or hinder side of the testis is an elongated curved mass, the *epididymis.* The testes measure from one and a half to two inches inlength, and from one inch to one and a qnarter in width; the weight varies from six to eight drams, the left being usually a little the larger.

The internal structure of the testis is quite eomplex, on account of the minuteness of the parts, and their great number. These are minute coiled tubes, separated from each other by fibrous partitions. The straight terminations of these are called *vasa recta.* These unite in a network called *rete vasculosa.* This above gives off several *vasa efferentia*, which again by foldings and intertwinings constitute the ***epididymis***, which is about twenty one feet inlength, a very convoluted canal. This ends below in a single large tube, the ***vas deferens***, and this, after rising out of the outer border of the epididymis, ascends, together with the vessels and nerves of the testis, all together constituting the ***spermatic cord***. This cord passes through a narraw canal, the ***inguinal canal***, which connects the cavity of the scrotum with that of the abdomen. The vas deferens ascends still higher to the side of the bladder, where it turns and ascends again nearer the middle line than the ureter of the same side, and likewise becomes thicker and more saculated. Just at the margin of the prostrate (a gland present only in the male, surrounding the neck of the urinary bladder and the commencement of the urethra), the vas deferens gives off an elongated blind pouch named the ***vesicula seminalis***, which serves as a reservoir of the semen. [The semen or sperm or gone is the fluid produced by the generative organs of a male by which impregnation is effected. It is usually a whitish viscid fluid containing innumerable spermatozoa.]

From the following description of the parts it may be seen how the vas deferens opens into the urethra.

Upon the middle line, and surrounded by the prostrate, is a sac-like organ which opens by a slit-like orifice in the middle line of the urethra. This organ corresponds to the ***uterus*** and ***vagina*** in the female, and is hence termed the uterus masculinus, the utriculus, the ***vesicula prostratica***, and the webrian organ, after its discoverer. The vas deferens is about two feet long; it is lived by mucous membrane, and its walls contain some unstriped or involuntary muscular fibres which give it a contractile power. The vesicular has a similar structure.

The most important element of the testicular secretion are the motile *spermatozoa*, which are involved in the interior of the cells as called *vesicles of evolution*, by spontaneous division from the parent cells. In this act of splitting it is possible to distinguish a male and a female element which, however, coalesce. These spermatozoa &c, are very commonly found in the ***rate testis*** and *vasa efferentia*, lying in bundles within the parent-cells, and are usually set free completely by the time they reach the epididymis, though still frequently associated in bundles. Besides the spermatozoa, the generative secretion (known as gone, semen) is formed of several secretions from the various cells from food-products drawn from the blood. These are the secretions of the epdidymis, the vasa deferentia, the vesiculæ seminales, the prost-ate glands, and of cowper, the lacunæ and follicles of the urether, added later in the process.

At the time of ejaculation the secretion of the prostrate gland and the testicular secretion are visibly different, the former being colorless, the latter creamy, and odourless. But in contact with the air they soon mingle. It is supposed that they both dilute and increase the bulk of the testicular secretion, so as to facilitate its reaching its proper destination.

The act of copulation has a strong tendency to promote the activity of the secretion of the sperma. During the coitus the muscular elements of the testicles, and some of the contractile fibres which surround the veins of the spermatic cord contribute their share in the action by delaying the flow of blood in the veins, thereby producing in the testicles a congestion that is favorable to its functions. Hence there is in the spermatic apparatus a vascular swelling which is in relation with that of the more particular erectile organs. The original sperma has the opportunity and time of being mingled with this latter liquid of the prostrate gland in as much as it accumulates slowly in the vesiculæ seminales in the internuissions between sexual embraces, In fact, all the processes which accur in the course described above from the testicle to the vesiculæ seminales, take place in a slow and continuous manner, presenting only a slightly increased activity under the influence of the genital secretions. It will, therefore, be obrious that the process of the secretion of the semen is at any rate not the affair of the moment. The spermatic cord is where the semen is stored for a length of time at any rate, but more particularly the vesiculæ seminales are its natural reservoirs, especially as the most nature gone is to be found in their neighbourhood. No moral force can stop the sperma from being a bundantly secreted in the testicles, from circulating in the vasa deferentia, thus to rice to the vesiculæ seminales, of filling and distending them; in this state it i s absolutely necessary that the vesicles shall empty themselves; if it be not voluntarily, it will be involuntarily; the catastro-will occur at night, in an erotic dream. The spermatic secretion is not interrupted, for a moment till old age, the vesiculæ seminales are therefore condemned to be filled incessantly, to distend, and empty themselves continually during the virile age. If the sperma does not go out in one way, it will do so irresistably in another. One can choose between sexual relations, and nocturnal and diurnal pollutions, but should not speak of continence. Vows of chastity should be left to angels. The man who swears to be chaste does not know the extent of the agreement with himself that he assumes ; he would be less daring if he knew that he was swearing to stop an organic circulation over which the will has no mastery. There is no question but that permanent impotence which is not to be imputed to moral causes or old age, or the state of the organs, must be due to daily and insensible seminal losses.

The semen unexpended through want of coitus or mental and moral impulses is reabsorbed through the lymphatic vessels abundant in the walls of the vessiculae seminales and the vas deference. So it has to be attributed the general manly physical and moral vigour, as it is the vifying agent of young or adult individuals who have active testicles. The signs of virility thus depend on the lymphatic reabsorption of the spermatozoa, not of the other liquid secretions of the vas deferens. The reabsorbed semen is poured into the blood by the large lymphatic duct immediately it leaves the heart. The blood nourishes the tissues of the muscles, and makes them firm ; it nourishes the muscles wich make angularity of form; it nourishes the tissues of the vocal organs, and the roots of the hair of the chin and genital member. It feeds the nervous centres and is the basis of the highest mental function, the most energetical action on the spinal cord. Besides, its presence after puberty as much determines the vigour and power as its absence permits the vocakness and diseases which are proverbial, or the absence of the signs of virility in the cases of eunuchs.

The activity of the male genital organs is when they are swollen and distended by the blood. It takes place also when the proxinity of the female or lascivious thoughts awake the sexual nature. Beyond these accidental causes, there is also a natural period for rheir activity. This occurs every morning, just during the last sleep, which is on this account the sweetest and deepest. It often happens in the neighbourhood of 6 to 7 a.m; but individual peculiarities and circumstances may vary this to some extant. In this manner there is a regular reabsorption, strengthening the body for the work of the new day. To this is due that virile brightness, that poised self-conseiousness and clear intellectual insight which returns every morning, in normal circumstances. It is a mistake to attribute this wholly to sleep. It is evident that it is to a certain extent more to the advantage of the brain tissues that they be fed even for a short time by regenerate blood in waking hours during the morning, than for a whole night on comparatively impotent blood in brutish sleep.

Man is a part of the universe, and can never save himself, that is, change himself for the better, without in some degree affecting the universe for good. If he would change himself, he must utilize all the resources of the universe which lie within his reach. In order to change himself for the better, he must know himself, and the universe, or he could nothing. From experience it is seen that the seminal germs are born, natured and transmited at times predictable for years ahead, when the exact position of the stars, earth and planets at the hour of birth are known accurately.

The proofs for the reabsorption of the semen, commonly known as regeneration are.

(1) The notable difference between normal and castrated individuals, as seen in the flesh and skin, from

being tender and delicate &c, and irritable, becoming coarse and firm; the body in general losing its succulency; the voice losing its tenderness and in equality and becoming ungratefully harsh; hairs protruding on parts equally smooth with the rest of the body; and the mind itself acquiring new propensities and passions.

(2) Old age, when with the ceasing of the testicular secretions, the body begins to decay, slowly at first, but when the table-land of middle-age has been left behind, the slope becomes daily more precipitous and rapid. It may also be noticed that continence prolongs life and incontinence hastens old age. It is clear that the weakness of old age depends largely on the diminution of activity of the spermatic glands, while the vigour of the neraous centres and other portions of the organism is bound with the swiftness of the testicular secretion process.

(3) The case of nocturnal emissions. It is of no consequence unless more than once a fortnight. When they are the expression of a real need, they are followed by a general feeling of wellbeing; the head is lighter, the ideas clearer, and all the wheels of the organism seem to have been oiled; the lungs work easier in the chest, all the movements are freer, more skilful and quicker. Spermatic plethora reproduces itself with fair rapidity with young men who have escaped the desolutions of masturbation; a general state of irritability; troubles and inexplicable anxieties agitate there, their character becomes harder; they become impatient and irascible; they seek solitude, and shed tears; sleepy but unquiet; some grow disgusted with life and seek suicide; others have immence aspirations and giant passions. A pollution which may will be called

critical ends all these disturbances, and reestablishes in a moment the harmonious equilibrium of the organs and functions.

No doubt, absolute continence does produce a nervous, sleepy, excifed state. But it is only owing to the super abundant vitality just begining to enter the blood by reabsorption. A little physical exercise will assist the general circulation and facilitate the desired process, after which a great increase of mental and moral power will be noticed. This is the proper remedy.

The above considerations suggest that in order to attain the highest state of health it is advisable to store up and preserve all the genital secretion. This is not impossible from the fact that the generative function is ***par excellence*** of all vital functions of the body that one most directly under the control of the mind. The sexual function is different from all other physical functions in that it is more than any other within the control of the will. To live, it is necessary to eat and drink regularly. Of all the vital functions, it is the one most easily guided and controlled; consequently, the conscious subject is much more responsible for its exercise than for the function of other organic processes, such as breathing, the circulation of blood, and the secretion of the digestive tract. Among animals, it is voluntary only during certain periods of the year; with children, not at all voluntary until the age of puberty. But with the adult human being it is wholly all the year round within the control of the will, or can become so, by taking the proper means. Hence a man is wholly responsible for the exercise of this function. The immediate result of this will be a perfect physical body, next increased faculties, and finally, the nourishment and development of the highest nervous centres leading to the full development of the spirit. Such an effect need not be doubted as unmarried men, as a rule, who preserve themselves pure possess a keenness or edge of perception which they lose after marriage. Similarly, the chaste man possesses a brightness of the eyes, a smoothness of the skin, a firmness of muscle, a magnetism of personality, a clearness of thought that is in exact opposition to the phenomena attending onanism and in a less degree of normal exercise of the sexual function. It may therefore be expected that the man who controls all loss of the gone will heighten the tides of vitality to the very maximum of which his organism is capable, up to the very limit of his possibilities. Of course, pleasure and self-indulgence, physical luxury and abandonment to comfort must be given up. Nothing less than this can purchase it, and nature cannot be deceived or defrauded. Pleasure on the one hand and happiness on the other; each man must choose for himself. It would not be inapt to quote here the words of the enlightened Mrs. Margaret B. Peeke: "If the fact were known that a life of purity in thought, word and deed would bring to a man a supremacy of which he now has but the faintest dream, that by it his life would not only be increased in length, but that all sicness and poverty would be unknown, and even death lose its terrors and cease to exist, mere selfishness would drive men from their present life of animality to the new life of regenerate sons of God." Here then is the higher self-controlling the lower self, the spiritual man ruling the natural man. As the first natural generation ushered man into the physical world, so the second spiritual birth, will usher him, by a power life, into the higher realm of heaven.

The highest individuation, above dealt with, is evidently computible with absolute sterility, i.e., repression of the act of reproduction. This would imply a celibacy or marriage for the sake of companion ship alone, and would demand a repression of all the pleasures consequent on the gratification of the sexual function, and even of those thoughts which tend towards awakening its desires. Only when the soul has its full normal powers, which appear when the physical organism is in perfect condition by reason of absolute self-control, can it become conscious of the spirit, and use its higher powers for a more inteligent guidance and control of the life.

ONANISM.

By it is meat causing loss of semen by (unnatural means) by the repitition of consulsive and voluptuous shocks.

Premature decadence of the mental powers, premature exhaustion of the energies, premature inability for nigrous and active exertion, result from excessive self-indulgence in early life. The young man, full of life, boiling over, as it were, with energy and activity recently loose from the restraint of school or college, un accustomed to control himself or to deny any gratification, lecunches out into excesses which at the time appear to be indulged in with impunity But sooner or later comes the day of reckoning. He has felt himself possessed of abundant energy, and he has dissipated it tearshly, feeling that after each wasteful expenditure he had more to draw upon; but he is in the position of a spend-thrift who is living on his capital. Had he husbanded his resources and lived with neoderation, the interest on his capital would have sufficed to keep him in comfort to old age ; but he has ladished his capital ; lived a few short years in great profussion, and before middle life he is a beggan.

Yet further effects from onanism or masturbation are likely to ensue sufficiently pronounced to incapacitate the wretched individual for the duties of life and to render it necessary to commit him to asylum care. The repeated loss of energy eventuates in a state of energy, apathy, lethargy and dementia. The tension of energy in the nervous system is reduced to the lowest ebb, and all the manifestations of existence of this energy are wanting or are exhibited in the feeble and perfunctory shape. The condition is one of dementia; there is want of mind, the inability to perform mental operations of even moderate difficulty, the dulness and slowness of feeling, the loss of all the higher emotions and of many of the lower ones also. There is a deficiency of movement, the absence of muscular exercise, the inability to make exertions that are at all prolonged or continuos, the general degradution of conduct, the loss of all the higher attributes of humanity and the retention of all the lower and more animal characterestics. This bad habit is no less disastrous with girls and immature boys, who have no seminal secretion to lose, as with boys who have passed the age of puberty. The nervous evil is thus limited to immature boys and girls ; the serious harm to mature boys comes from the loss of the seminal fluid.

CHAPTER III

MARRIAGE AND ITS EFECTS.

Marriage is the civil status of a man and of a woman lawfully united in the relation of husband and wife. It is a sacrament with the Hindus performed for religious objects and ends, and affecting the religious state of the man both here and here after, and it continues for ever. Any way, it confers serious responsibilities an both of them, and conduct in defrance ef such responsibilities will expose them also to public ignominy. It is a firm sacred union of two persons of different sexes, for the purpose of mental support, and for producing and educating children and for the sake of paying to humanity the debt of continuing the race owed by every one to it. It is one of the most essential parts of the destination of men, both for the individual and the whole, and an establishment absolutely necessary for the education of mankind. In this intimate union lie the principal grounds of domestic as well as public felicity. In the first place, it is indispensably requisite for the moral perfection of mankind. By this close connection of two beings, this association of one's interest with another, is selfishness, the most dangerous enemy of all virtue, best subdued; and man always more inclimed to humanity and compassion for his fellow-creatures, and still brought nearer to his true state of moral exultation. His wife and his children form an indissoluble bond which unites him to the rest of mankind, and to the good of the whole; his heart is always warmed by the sweet sensation of motrimonial and parental tenderness, and, defended from that deadening coldness which so easily overcemes the man who leads a solitory life ; and the endearing caress of a father impose on him duties which accustorn him to order, industry and habits of prudence. His passion for the sex is emobled, and converted into one of the highest moral motives of action ; and violent passions, ill humour and bad customs are thus best eradicated. Happy marriages are the most important supports of a state, and of public peace and felicity.

A bachelor, even one following concubinage, always remains an egotist, restless and unsteady, a prey to selfish humours and passions, less interested for mankind, for his country, and the state, than for himself. He is overcome by a false sentiment of liberty which prevents him from entering into wedlock, and this sentiment is still nourished and strengthened the by condition in which he lives. It is an increase of unmarried citizens that can tend more to produce a foundness for change, seditim and revolutions.

But in the case of the married, the dependence on the other half, regard for the wife and children obliges one to be regular and industrious ; by his children he his attached closely to the state, its interest and prosperity by these means become his own, and a foundation is laid, not only for the happiness of the present generation, but for that of the future also.

The beneficial influence which marriage has on the physical good of mankind is :—

(1) Marriage is the only means to regulate love and to direct it to its proper object. It equally prevents debilitating dissipation and cold and unnatural indifferences. No power in man must remain totally unexpended ; each must be exercised in moderation-

(2) Experience shews that all those who attained to a very remarkable age were married.

(3) The Married state promotes domestic joy, which is the purest, the most uniform, and the least wasting of all. It is certainly that which is best suited to physical as well as moral health, and which can preserve the mind in that happy mean state most favorable to longevity. It tends to moderate over-stained hope and enthusiastic speculation, as well as excessive care. Everything, by the partioipation of another being, by the intimate connection of our existence with that of another, is rendered milder and more supportable. To these may be added that tender charge, that heaven on earth. secured by nothing so much as wedded love, which lies in the possession of healthful and well educated children; that actual renovation reserved for us by their company. We begin as children and as children we leave off. We return at list to the same weak and helpless condition as our first. We must have people to lift us, to carry us. to provide us nourishment, and even to feed us. While our weakness transposes us in to the place of children, the children then step into the place of parents to lend us that support and assitance which can be the work, only of natural and the affection bonds of nature.

The modern tendency in marriage is to regard the relationship as a contract inwhich each party should have equal rights and equal duties, but there are difficulties in the way of adopting this method. The natural incidence of the burden of reproduction is not equal, for which the man's part is small, the woman's part is large. Complete equalization involves the economic dependence of the mother but the mother cannot at once be an effective child-bearer and an effective bread-winner. The matter is adjusted by assuming that the women bears the child for her husband, and that in return he supports her and it. This again lands us in another inequality, viz, the child belongs to the father, although on a natural basis the child belongs primarily to the mother, of whose flesh and blood it is formed. The difficulties of marriage are further increased by the complexity and individualizatiou involved by civilised life. The present-day tendency is for like to mate with like. With an increased development of faculities and tastes, and the increased complexity of individual demands, successful mating become much more difficult—all the more so since its success cannot be determined until the decision is already irrevocably made. The above line of argument totally ignores the divine hand of providence in each and every affair, however minute it may be an earth, or the steller and planetary influences acting upon every created being, or the fact of marriage being for paying to humanity the debt of continuing the race owned by every individual to it.

However, this need not demand more than one or two exceptions to the rule of self-control, and may in every other respect lead to perfect health, and, in addition to this, to the great joy of sacrificing one's own interest and welfare to that of his children. Such married continence may increase the health and welfare of both husband and wife, increase their mutual love, purifying and chastening it, and finally, when the sexual intercourse takes place, entancing its delight since the pleasure consequent on the exercise of such a function varies inversely as the frequency of its occurrence. Yet, beautiful and noble as this state is, it is exceedingly dangerous; for the boundaries of the highest ideal are but vague is close to them in practice. The most innocent caresses may become the greatest source of danger; he indeed is the hero who can withstand all temptations unharmed.

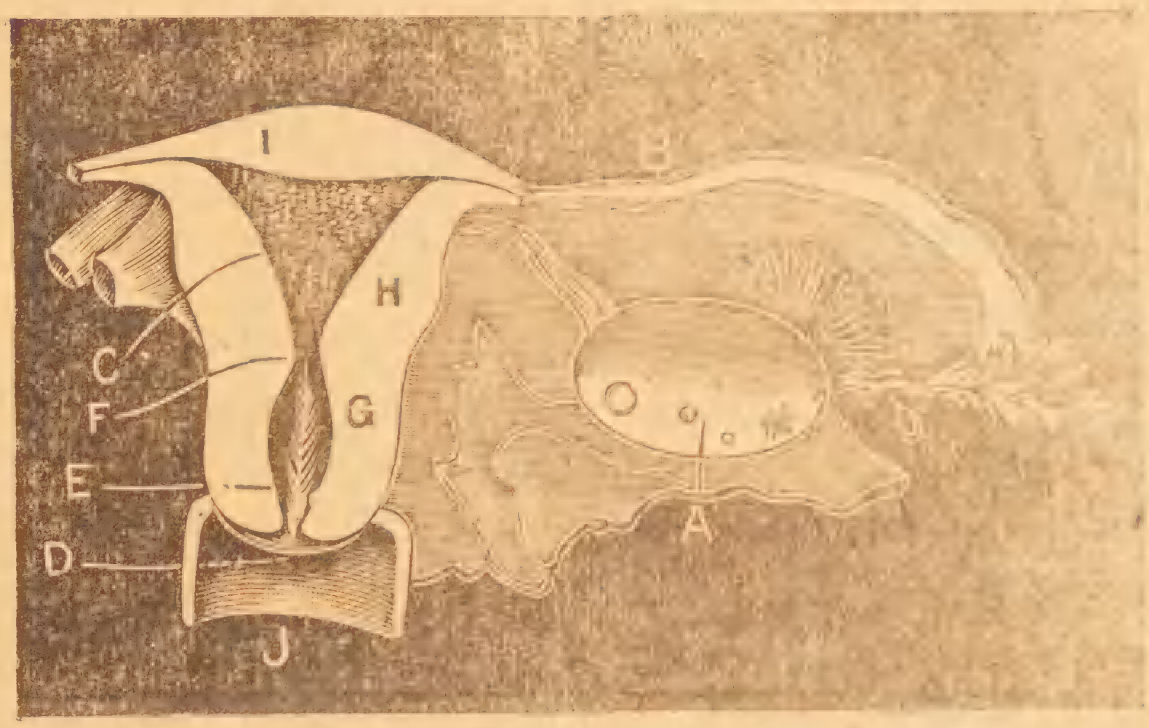
In the case of marriage being for companionship alone, its necessity is only a tribute to the existing customs of society. This is landable in as much as it keeps the body politič together, although to men and women determined to attain this highest degree of individuation it is useless. Yet, under existing circumstances, it permits them to live together.

Again, the state of marriage is the less dangerous but equally helpful state of celebacy. Here the dangerous are few, and if there be no intention of procreating children, here the individuality can attain its maximum development.

CHAPTER IV.

THE FEMALE REPRODUCTIVE ORGAN.

The productive glands in the female are a pair of ovaries, situated one in each side of the pelvis in the groin. The pelvis is a bony girdle by means of which the lower limbs are attached to the trunk. The bones forming it are the sacrum and the coccyx at the back and in the middle line, and an os innominatum or haunch bone on each side. Although fused and unified in the adult, the haunch bone in early life consists of the ilium, the is chium, and the pubis, each of which has a share in forming the cup-shaped cavity for the reception of the rounded head of the femur or thigh bone. In the erect attitude the bony girdle is placed obliquely to the trunk. The pelvis of the female is lighter, shallower, and more expanded than that of the male; but in both sexes the constituent bones are of great strength and regidity, and support the bulk of the body. The bony strength also serves to protect the delicate organs (bladder, uterus, rectum) which lie in the cavity of the true pelvis. This cavity is continuous with, and is really a part of the abdomen, and it is lived by peritoneum, the folds of which form the lateral and other ligaments of the uterus and appendages.



* " Each ovary abovementioned is an elongated dassage or tube called the Fallopian tube which leads to the uterus and opens into its cavity. The overum having passed through the tube, reaches the cavity of the uterus, and in it, (spermatozoa, having in the meantime entered

through the external os, the cavity of the cervix, and the internal os, reach the cavity of the body of the uterus), unites with the spermotozoon, when fertilization takes place. Then the ovum undergoes development into an emboy and factus. The ovary is a solid body, flattened from side to side, and about the size and shape of a large almond. Its length is usually between 1 and 1½ inches, and the thikness from side to side between ¼ and ½ an inch.

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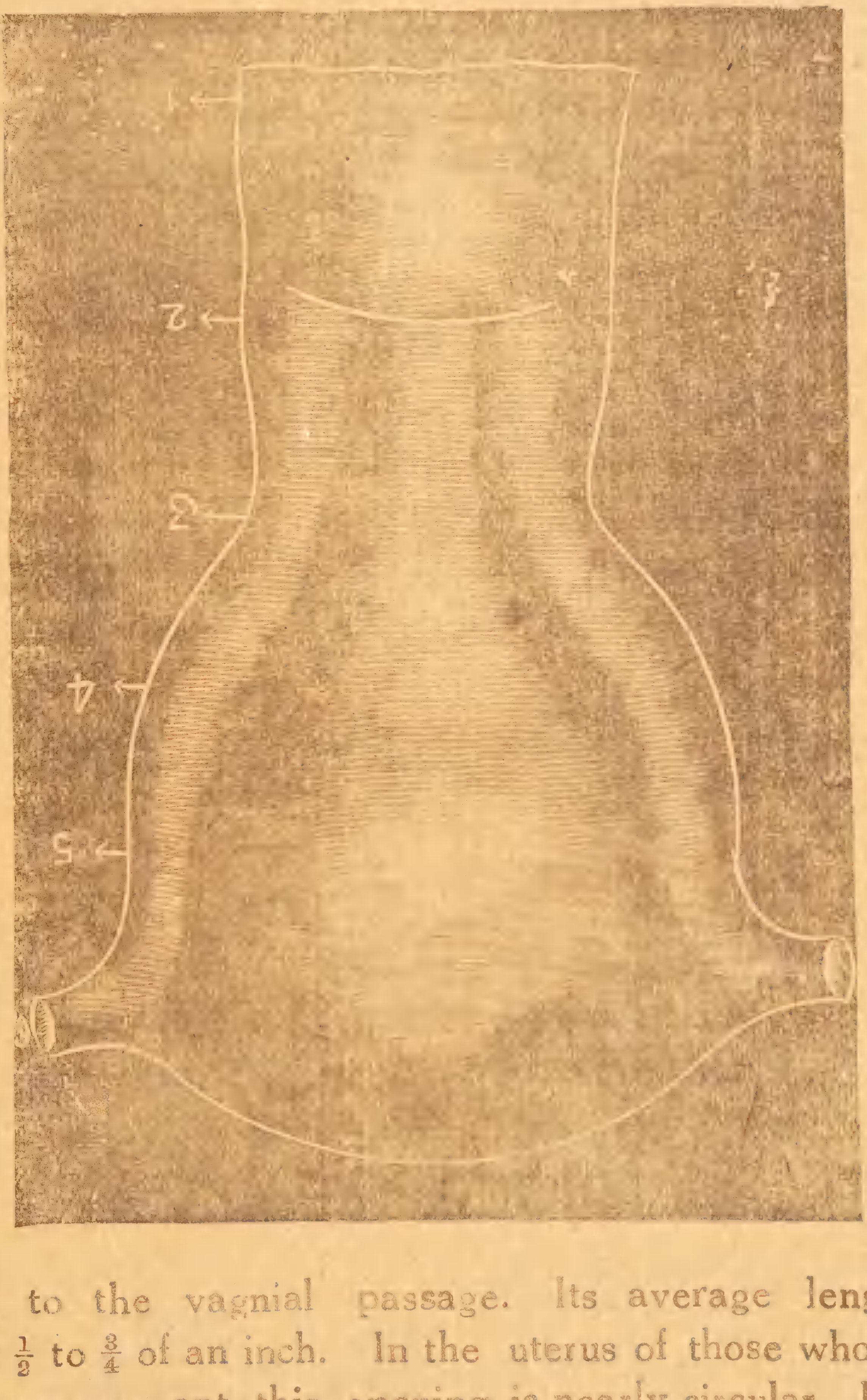
* Extracted from the work " Limitation of Family"

The Fallopian tubes are a pair of passages which convey the ova discharged from the ovaries to the cavity of the uterus. Each tube is about 4¼ inches in length. The uterus or womb is a hollow or thick-walled, muscular organ placed within the pelvis between the bladder in front and the rectum behind. The ova discharged from the ovary enter the uterus through the Fallopian tubes, and if fertilization takes place, undergo their development within it.

The uterus consists of two parts, the body of the uterus, and the cervix or neck which opens into the vagina. The external form of the uterus is somewhat pear-shaped. The upper end of the uterus projects upwards and forwards into the pelvic cavity; while the lower (more constricted) part is connected with the vagina. The usual length of the adult uterus (when non-pregnant) is about 3 inches, its greatest breadth the nearly two inches, and its maximum thickness about an inch.

The neck or cervix uteri is cylindrical and narrower from the rest of the uterus. Its length is about an inch and its interrior end tapering somewhat enters the upper part of the vagina. This (the infra-vaginal portion), which projects into the vagnial passage has, at the apex of the rounded cone, an opening (external os uteri) leading on the one hand to the cavity of the cervix, and on the



other, to the vagnial passage. Its average length is about ½ to ¾ of an inch. In the uterus of those who have not been pregnant, this opening is nearly circular, but in those who have borne children, it is usually a transverse slit with a somewhat irregular out line. In front of and behind this opening, the cervix forms two lips, an anterior and a posterior. The anterior lip is thicker and slightly more rounded; it is on a lower level than the posterior lip which is slightly longer and thinner. The cervix enters the vagina through the upper part of its anterior wall. The os uteri is the seat of ovarian pain, congestion and sterility. In women who have brought forth two or more children at a birth, the os uteri is large and dilatable, or fissured and lascerated as a consequence of labour, and possibly, in strumental delivery. In pregnancy it may partake of the characterestic general softening and is soft and expanded.

The cavity of the uterus is small owing to the great thickness of the uterine wall The cavity of the body joins the cavity of the cervix by the opening termed the internal os uteri which is a little smaller and more circular than the external orifice of the uterus The cavity of the cervix—the cervical canal, extends from the internal orifice of the uterus, where it joins the cavity of the body, to the external orifice where it opens into the vagina.

The vagina is a passage from the vulva to the womb; about 3 inches in length, opening at its lower end and communicating above with the cavity of the cervix. The vulva is the opening into the vagina. The fourchetre is a small fold connecting tha labia of the vulva in the female. The hymen is a thin membrane, extending across the vagina at its entrance, semiluner, circular, or irregular in form.

MENSTRUATION.

Menstruation, the monthly period or catamenia, is a periodic discharge of a sanguineous fluid from the non-pregnant uterus, due to the shedding of the lining membrane of the uterus and is usually associated with the separation of an ovum from the ovary. This periodic discharge ocurs between the ages of puberty and the climacteric (a period of marked change in the human physical constitution), though the on set and duration is subject to considerable varietions in health. The average date of the first appearance in temperate climates is the twelfth or thirteenth year; it occurs earlier in the inhabitants of hot climates and in girls leading luxurious lives. The date varies with the differences of climate, race, constitution and way of life. It becomes irregular about the forty-fifth year and usually ceases by the fiftieth year. Menstruation usually occurs every twenty-eighth day and lasts from three to six days. In some cases it recurs regularly every three weeks; in others the intervals are longer than a month. It is usually attended by pain in the loins, and senstations of fatigue in the lower limbs and other discomforts, most marked during the first twenty-four hours.

For the first 12 or 13 years of a girl's life, the uterus usually retains its infantile condition, but at puberty it rapidly begins to increase in size, the breasts becoming larger and menstruation begins. Invariably, the progeny of the wealthy and the town-reared menstruate earlier than those of the poor or the countrybred. An atmosephere of sexual excitement, idleness, luxury, the use of rich and highly seasoned food, condiments and stimulants hasten menstruation. During this critical period, one or more Graafian follicles are ruptured or burst, due to a congested condition of the ovaries or a heightened blood pressure in them and accessory structures, and set free ripe ova borne away by the sanguitorrent down the Fallopian tubes, which lodge themselves in the uterus, and if not fecundated, perish and are expelled. Depletion of vital force is marked so plainly that none can deny the causal connection between the two symptoms. In case the periods are excessive or too prolonged or too frequent, medical aid ought to be sought to avert serious consequences. The process becomes irregular with excitements of stimulating food, general false habits, continual overexitement and over exercise of the generative organs. It is said to have close connection with the lunar periods. It should be noted that such a period exists in man, the external symptoms being less marked, but just as regular as in the case of woman.

The menstrual fluid is not blood, but resembes it much. In healthy state it does not clot like blood. When menstruation is regular as to quantity, quality and time, the indication is that the womb is sound and the body healthy. Defective menstruation will denote poverty of blood and general debility. It is therefore necessary that the matter of menstruation ought to engage the attention of every wife, as that of urine the attention of a male. Disorders of menstruation may arise from the impairment of the general health, or from an alteration in the position of structure of the womb Deficiency or absence of discharge may be due to an acute ilness as chill, to mental excitement or general debility. A profuse menstruation and hæmorrhage from the uterus at any other time than a catamenial period may be caused by many lesious, tumours of the uterus, displacements and congestion of the organ due to obstruction to the circulation in cases of heart, lungs, or liver disease. Painful menstruation is often met with in women leading luxurious lives, and in debilitated or nervous persons. Its symptoms are dull acting pain in the loins replaced by s sharp pain in the pulvis, and radiating to the sacrum, groin and thighs, the flow usually intermitting at the same time.

Menopance or the climacteric, is the time when, in the human female, the activities of the ovaries finally cease. It occurs, as a rule, from 45 to 50 years of age, its development being slow and extending from 6 to 24 months. It is characterised by marked irregularity of the periods, flushings of the skin, giddiness and other manifestations of nervous irritability. The severities of these symptoms varies largely with the constitution of the patient and with the circumstances of her life. The anatomical characters of the menopanse are a shrinkage and atrophy of the overies, fallopian tubes and uterus. Headache irritability of temper, loss of memory, depression, vertigo are among the unpleasant symptoms happening during this period. While menstruation lasts, a woman is liable to become pregnant; as a rule, when she "ceases to be unwell" she ceases to have progeny, but there are exceptions.

During menstruation, violent exercise or sexual intercourse is harmful, and coitus is very dangerous to both the man and the woman. The mind and the temper should be kept calm and equable during the period.

CHAPTER V.

CONCEPTION.

Every lunar month, the female elements the ova ripen in the ovaries, on the right and left side of the womb, and these ova, when they burst forth and glide through the Fallopian tube towards the womb When once they are detached from their ovaries, must go to waste unless met by the spermatozoa and held in the uterus to impregnate. The seminal fluid, we have seen, contain spermatozoa. During coitus, these spermatozoa meet the ova in the female uterus in their way to the womb of the female and together coalesce. This meeting and coalescence is impregnation and a larger cell (embryo) is formed as the beginning of a new individual—the rudivents of the future form and quality of a human being. It will be hypothetical to reason as to the number of spermatozoa necessary to impregnate an ovum. The father has no further part to play than to love, protect and work for the mother who carries the child in her womb. No sooner does the conception take place than nature closes up the entrance to the womb. The womb is lived inside with a spongy mass of vessels, and into this, the blood of the mother soaks and fresh blood issues to feed the child. A cord runs from the spongy mass to the child's body to carry blood to and from the child's body. The cord is the navel string or placenta. The placenta is a highly vascular sponge inwhich both fætal and maternal blood circulate. Within this sponge the fætal blood takes up oxygen and food material from the maternal blood, so that by the placenta the fætus

1

1st Month.

2

2nd Month.

3

3rd Month

4

4th Month

5

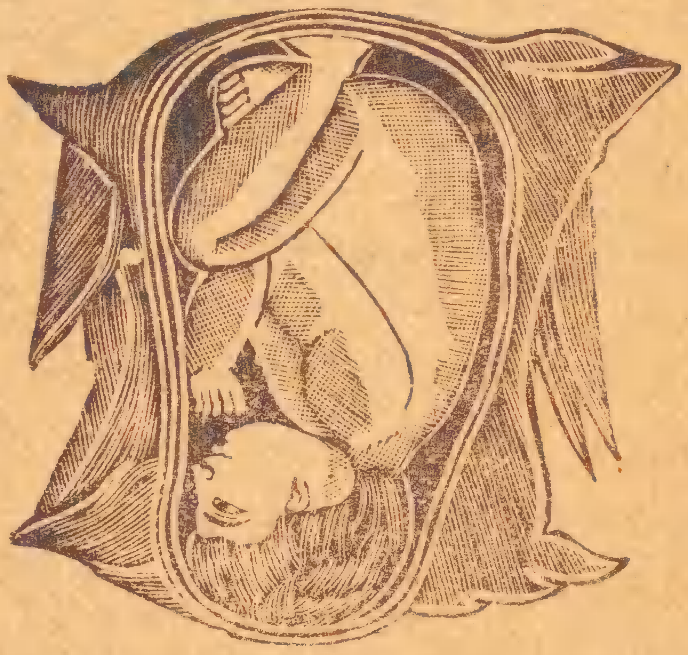
5th month.

until delivery. It is a physiological condition, and one which the thoroughly healthy woman living a healthy life, passes through with a minimum of risk and discomfort. The signs of pregnancy are fairly sure guides when occurring together ; but there is no one of them absolutely reliable alone. The menses are usually suppressed at the period following conception, and are absent until after some months after delivery, Menstruation may, however, cease on account of onæmia, mental shock, or chill. Morning sickness usually shews itself about the second month. It is usually early in the day, but may occur at

night. About the third month the skin round the nipples begins to get dusky in hue. About the fourth month the abdomen becomes slightly enlarged, and toward the end of that month the movement of the child in the womb may be felt. When all these signs and symptoms occur in their proper order, there is a strong presumption that the women is pregnant. But mistakes are frequently made

(1) by women who, having married late in life, wish to have children; in these cases the wish is often farther to the thought; (2) by women who fear they are pregnant, and so exaggerate certain signs, imagine some, and produce others through fear and hysterical conditions. Also, tumours in the abdomen may produce most of these conditions, or all of them, except quickening. But until a late

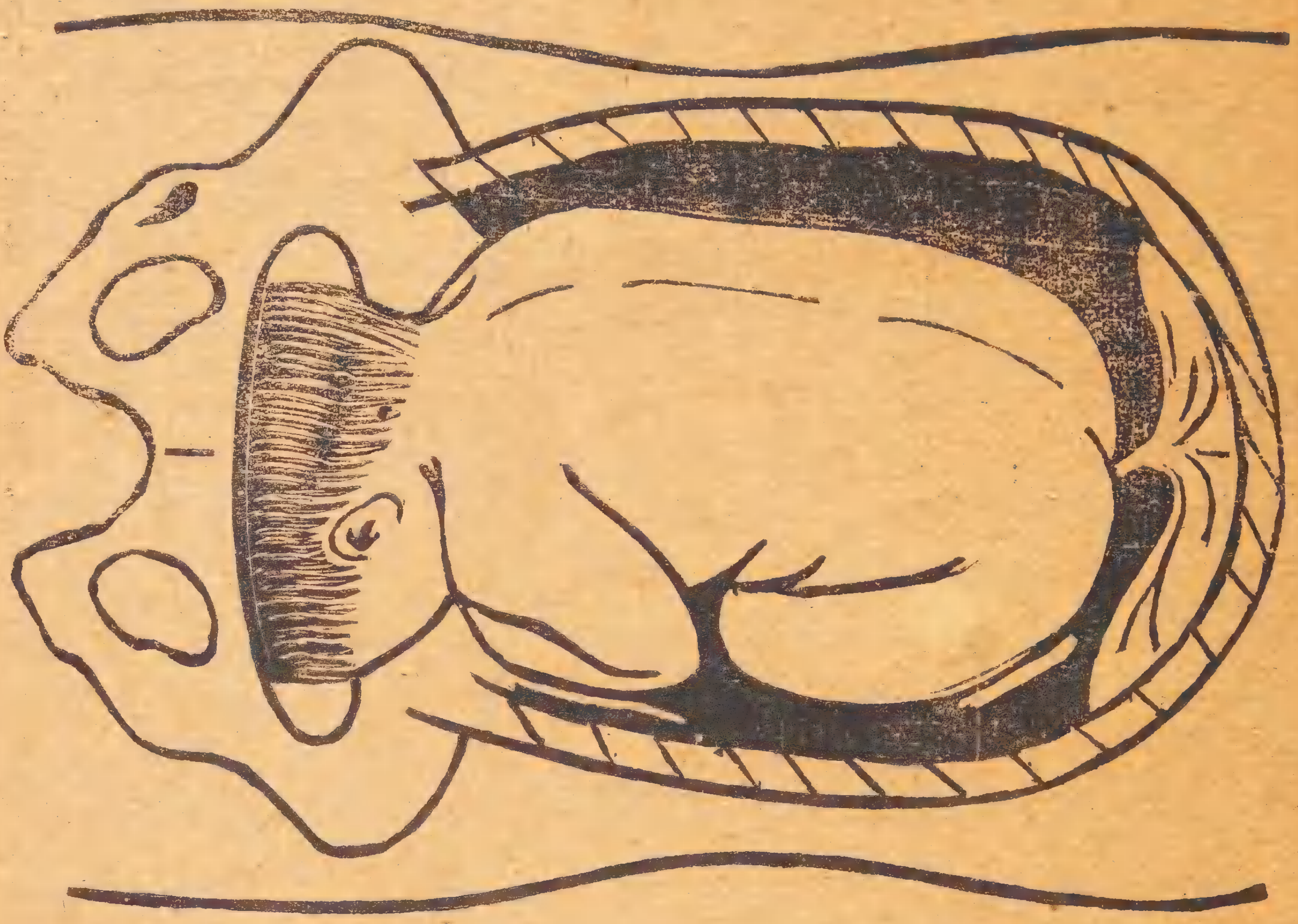
stage of pregnancy, there is only one absolute positive sign of pregnancy, and that is the sound of the fætal heart, heard through the stethescope; yet the absence of the sound is not absolute proof of the absence of pregnancy. Again, pregnancy may go on to full time without any noticeable quickening.

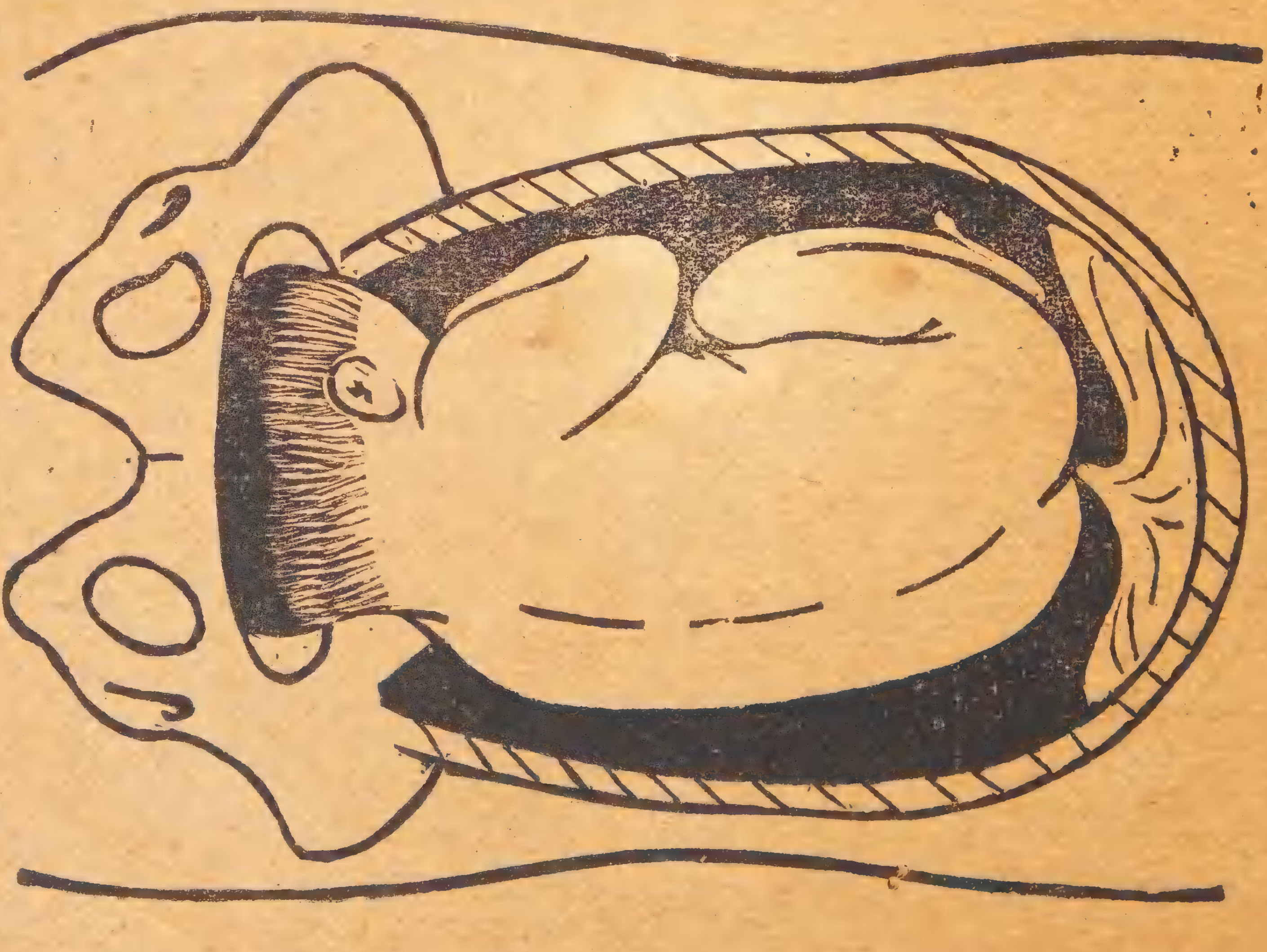


The life of a pregnant woman should be in most things conducted as usual with particular care against over-exertion, excitement and unhygenic acts generally Her food must be ample, plain, untritious Her appetite is usually considerably increased; but the unhealthy cravings sometimes met with for indigestible and even ordinarily uneatable articles must not be indulged. Alcohol must be most sparingly used, and in most cases is better done without; nor should excessive quantities of tea be drunk. She should take regular gentle walking exercise in the open air, and within reasonable limits keep to her ordinary activities about the house A sudden fright or long-continued anxiety may cause abortion, or may affect the the healthy development of the child in a general way, though not be causing special deformities. Hæmorrhage from the womb must be guarded against during pregnancy, by avoidance of sudden muscular efforts and long-continued exertion, for when hæmorrhage comes abortion is threatened.

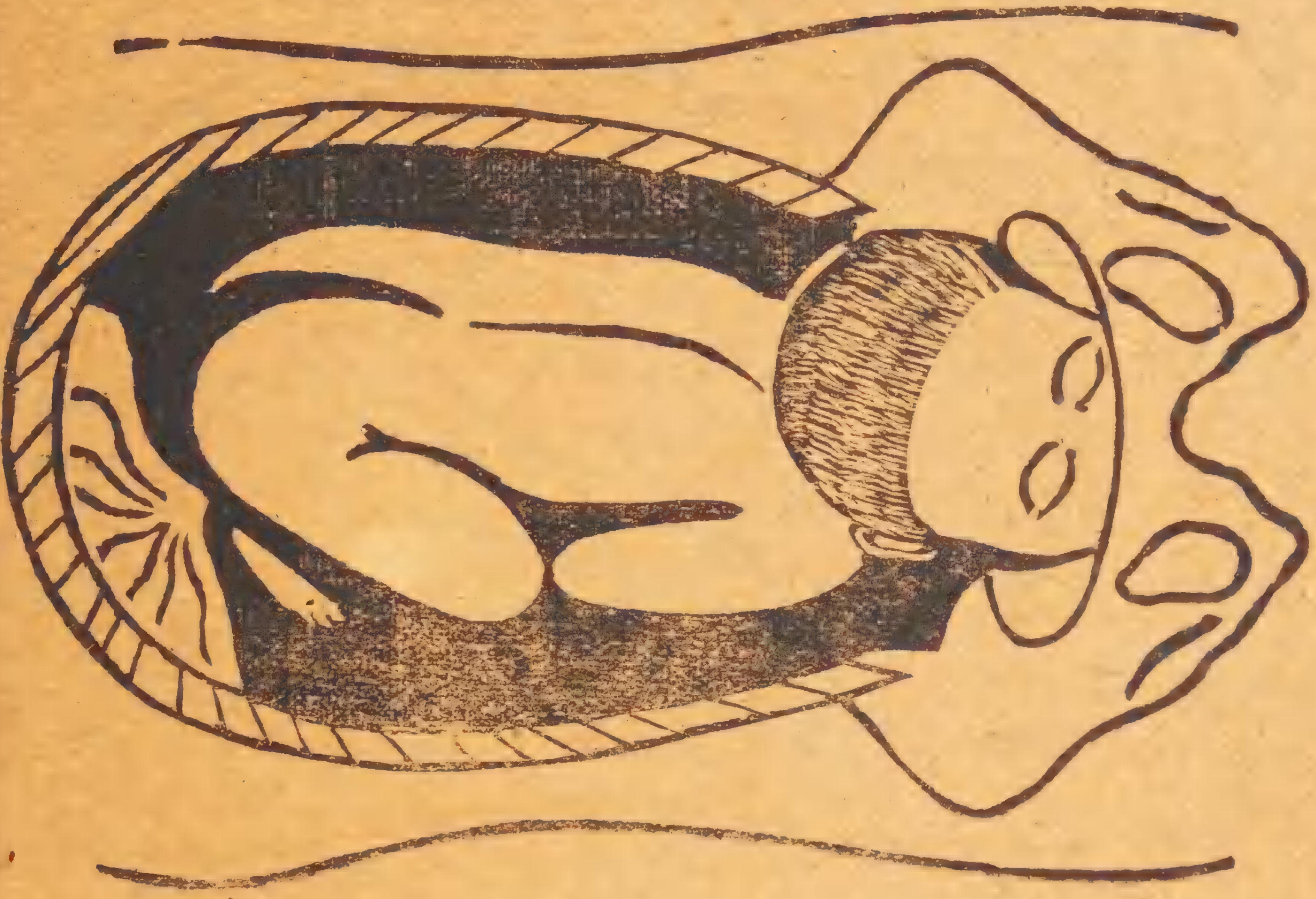
Pregnancy is a physiological condition where all the factors involved are functional in their normal way; but if the mother suffers from any extraneous illness such as scarlet fever, cholera, typhoid, &c., or if she has cardiac or lung disease, or if she has a misplaced uterus, the condition becomes abnormal, and abortion or any untoward symptoms may supervene. Again, if the lining membrane of the uterus be unhealthy, aborsion may take place; in the case of chronic disease in the parents various abnormalities in the lining membrane or in the ovum may supervene, which lead to its death and often to its premature expulsion. Occasionally the impregnated ovum develops outside the uterus, and the condition is known as extra uterine pregnancy. This condition is a very serious one for the mother, and calls for immediate surgical treatment. Hæmorrhage may arise during any part of gestation, & the in early months it is associated with a threatened miscarriage or abortion, and is due to any of the causes of an abnormal pregnancy. When it occurs with the on set of labour, it may be due to the misplacement of the afterbirth and is of very grave import. After the birth of the child postpartum hæmorrhage may be due to an injury in the maternal tissues or to the failure of th euterus to contract. This will require prompt treatment. The technical difference between the terms abortion and miscarriage should be noted. ***Abortion*** denotes the expulsion of a fætus incapable of life, i. e., when it occurs before the formation of the placenta or before the commencement of the fourth lunar month of the pregnancy It is ***miscarriage*** when it occurs after the formation of the placenta, and before the child is viable, i.e., from the fourth to the end of the seventh lunar month.

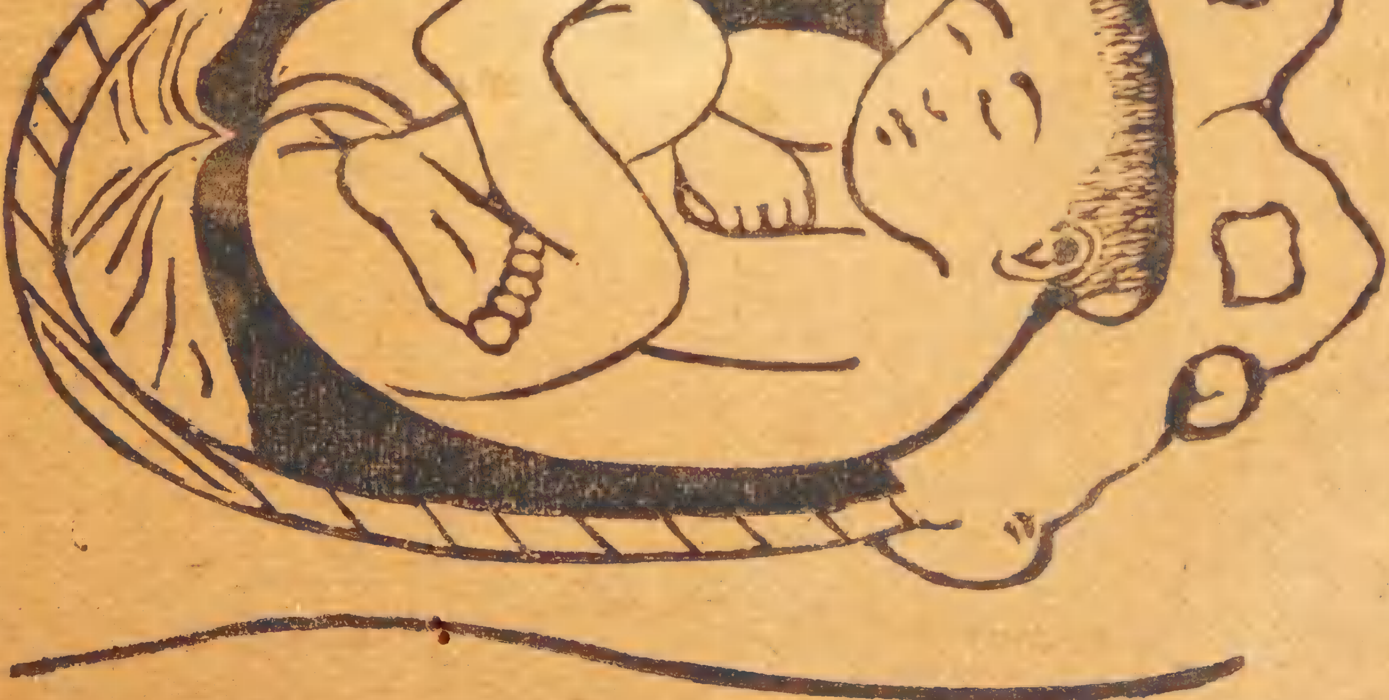
TEDIUS - LABOURS.





DIFFICULT - LABOURS





CHAPTER VI

LABOUR.

This term is applied to the train of events that ends in the expulsion of the child. It may be classified as follows ; 1. Abortion, 2. Miscarriage, 3. Premature birth, if it occura after the child has become viable but before full time, i e., before the end of the tenth lunar month. 4. Full time birth, when it occurs at full term. 5. Delayed labour, when it occurs more than forty one weeks after conception.

A labour is termed normal when the fætus presents by its vertex, the uterine contractions following one another in such a manner that everything is over without artificial aid in twenty-four hours. This train of events happens in about 90 per cent of labour. This process is divided into three stages-a stage of dilatation, a stage of expulsion or birth of the child, and the after-birth or the placental stage. The stage of dilatation commences with the onset of the uterine contractions, and ends with the full dilatation and the rupture of the fætal membranes. Its average duration is in primiparas (women in labour with the first child) from 10 to 12 hours, and multiparas (women who have each borne more than one child) from six to eight hours. The second stage commences with the full dilatation of the canal and rupture of the membranes, and ends with the expulsion of the child. Its average duration is from one to two hours in primiparas, and from ten to fifteen minutes in multiparas. The third stage commences with the birth of the fætus, and, ends with the expulsion of the afterbirth. Its duration depends upon the manners in which the stage is conducted. If the expulsion of the placenta is left to the natural efforts, the average duration is from two to three hours; and if, as is usual, assistance is given, the duration is from ten to fifteen minutes. In the general management of labour there are three essential indications: 1. To prevent any septic infection from being introduced from without; 2. to be on the outlook for any abnormal conditions which may threaten danger to the mother or child; 3. to reduce suffering to a minimum by the administration of an anaesthetic.

CHAPTER VII.

HOW SEX IS DETERMINED.

The question to be solved here is what determines an ovum is to develop into a male or a female organism. On the one hand, most of the careful experiments and observations on manuals lead to the conclusion that the sex of the offspring is fixed *ab initio* by the constitution of the ovum. In other words, there are ova whose organisation or metabolic bias is such that they will develop into male or female organisms no matter what natural influences may be brought to bear on them. They are predetermined from the first, & their bias cannot be altered. But this gives rise to the further question, if there are ova predetermied to develop into males and others into females, to what is this predetermination due to the nutritive condition of the mother to her age, to her constitution, or to what ? Or is the predetermination simply another expression of germinal variation, in which the complex germ—plasm is swayed more or less persistently to one side or the other by factors beyond our analysis ? As to this there are no secure data. There is also the other view, that the sex of the offspring is not predetermined by the constitution of the ovarian ovum, but remains for some time undetermined and modifiable. It may de that a number of factors co-operate to settle the open question of whether the ovum is to develop into a male or into a female.

Among the possible determining factors, the most important may be resolved into plus or minus nutrition, operating upon parents, sex-cells, embryo. Those who belive in the view that the sex of the offspring is determined or is alterable after the ovum has left the ovary, are on the whole agreed that favourable nutritive conditions tend to result in a production of females and *vice versa*, but furthermore that there are numerous factors which may exert their influence either in co-operation or in antagonism. At present the balance of opinion is in favor of the view that there is initial or ovarian predetermination. The essential feature of the process of fertilization being the union of the male and female elements, it will be plain that sex is fixed as soon as inpregnation takes place.

Varrious theories are advanced on this subject, the most important of which is that the secretion (spermatozoa) of the right testicle plus that from the right ovary together produce boys; that is, the secretion from the generative organs of the right side of the male and the female produce a male offspring, while the coalescence of the secretions from their left sides contribute to a female. A more practical theory suggested in the work " Limitation of family ', is that a conception had in the Bright ;fortnight results in a female issue whereas one in the dark fortnight leads to a male issue. This theory is said to apply even to animals and it is within the control of every one to verify. The reason underlying the above theory is not difficult to seek. If the law of conservation of energy means anything, it means a coherence of all existing things, i e., every cause, however infintesimal it may be; has a chain of effects which in some mannere affects the whole universe. Every part of the universe is thus corelated to every other part; hence, in one sence, every one thing is related to every other. The human frame is a machine wholly subject to the aforesaid law. The body of a man is practically part of the physical matter around him, and should share in its limitations. We see it highly differentiated as it is, being subject to the law of gravitation, and it must necessarily be subject to the law of chemical affinity, magnetism, and any other more spiitual influences, if there be any. We know that the moon, although so far every, plays an important part in the tidal changes of the ocean as well as in the rising of the sap in the trees. The influence of the lunar ray on the human brain duiing sleep has in popular opinion been held to for centuries. It is also at time powerful enough to produce color-blindness. The sun exerts an influence even stronger. The difference between the moods of the same person on a fine day or on a cloudy one is of common experience. Besides, were it not for the sun, all vegetation would stop, as is shown by the heroic feats of plants, even to pick their way through walls to arrive at the sunlight. Not only the flora, but also the fauna would decay without the light of the sun, and robust health cannot be attained without it, witness the sun-bathing at summer resorts. Of course, the most powerful influence of the sun, moon and earth, namely, their mutual attraction, is not noticeable by the immediate senses of man, but none the less, were these factors to change in the least degree, it is not inprobable that animal life would become extinct immediately. The above considerations will validate the inferences that the moon, exerting an influence stronger than that of the sun in the bright fortnight exercises an influence on the coalesced secretion tending to from a female embryo, while, similarly, the sun, whose influence is stronger than that of the moon in the dark fortnight, contributes to develop a male embryo.

THE PERIOD OF GESTATION.

This period is usually 270 to 275 days; and sometimes it may extend to 280 days from the termination of the last menstrual period. In case a wife should note the last day of her periods, it would save her much anxiety. In case she is put out of her reckoning by becoming pregnant without becoming "unwell", she should reckon from the time she feels the quickening which will take place about 125 days after conception and the remaining period to complete the full term of pregnancy may be easily arrived at.

HOW TWINS ARE CONCEIVED.

A woman may conceive and yet be unwell during the first three, four or five months of pregnancy. There is great risk then of her conceiving again. " If ovulation takes place during pregnancy, and if, owing to the occurance of coition, the ova become fertilized, superfætation

The Period of Gestation.

January		February		March		April		May		June	
Date of menses stopped.	Date of Delivery	Date of mecnee stopped.	Date o. Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.
January 1	October 8	February 1	November 8	March 1	December 6	April 1	January 6	May 1	February 5	June 1	March 8
2	9	2	9	2	7	2	7	2	6	2	9
3	10	3	10	3	8	3	8	3	7	3	10
4	11	4	11	4	9	4	9	4	8	4	11
5	12	5	12	5	10	5	10	5	9	5	12
6	13	6	13	6	11	6	11	6	10	9	13
7	14	7	14	7	12	7	12	7	11	7	14
8	15	8	15	8	13	8	13	8	12	8	15
9	16	9	16	9	14	9	14	9	13	9	16
10	17	10	17	10	15	10	15	10	14	10	17
11	18	11	18	11	16	11	16	11	15	11	18
12	19	12	19	12	17	12	17	12	16	12	19
13	20	13	20	13	18	13	18	13	17	13	20
14	21	14	21	14	19	14	19	14	18	14	21
15	22	15	22	15	20	15	20	15	19	15	22
16	23	16	23	16	21	16	21	16	20	16	23
17	24	17	24	17	22	17	22	17	21	17	24
18	25	18	25	18	23	18	23	18	22	18	25
19	26	19	26	19	24	19	24	19	23	19	26
20	27	20	27	20	25	20	25	20	24	20	27
21	28	21	28	21	26	21	26	21	25	21	28
22	29	22	29	22	27	22	27	22	26	22	29
23	30	23	30	23	28	23	28	23	27	23	30
24	31	54	December 1	24	29	24	29	24	28	24	31
25	November 1	25	2	25	30	25	30	25	Macrh 1	25	April 1
26	2	26	3	26	31	26	February 1	26	2	26	2
27	3	27	4	27	January 1	27	2	27	3	27	3
28	4	28	5	28	2	28	2	28	4	28	4
29	5			29	3	29	3	29	5	29	5
30	6			20	4	30	4	30	6	30	6
31	7			31	5			31	7		

The Period of Gestation.

July		August		Sep.		Nov.		Dec		October	
Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped.	Date of Delivery.	Date of menses stopped	Date of Delivery.
July	April	August	May	September	June	October	July	November	September	December	September
1	7	1	8	1	8	1	8	1	8	1	7
2	8	2	9	2	9	2	9	2	9	2	8
3	9	3	10	3	10	3	10	3	10	3	9
4	10	4	11	4	11	4	11	4	11	4	10
5	11	5	12	5	12	5	12	5	12	5	11
6	12	6	13	6	13	6	13	6	13	6	12
7	13	7	14	7	14	7	14	7	14	7	13
8	14	8	15	8	15	8	15	8	15	8	14
9	15	9	16	9	16	9	16	9	16	9	15
10	16	10	17	10	17	10	17	10	17	10	16
11	17	11	18	11	18	11	18	11	18	11	17
12	18	12	19	12	19	12	19	12	19	12	18
13	19	13	20	13	20	13	20	13	20	13	19
14	20	14	21	14	21	14	21	14	21	14	20
15	21	15	22	15	22	15	22	15	22	15	21
16	22	16	23	16	23	16	23	16	23	16	22
17	23	17	24	17	24	17	24	17	24	17	23
18	24	18	25	18	25	18	25	18	25	18	24
19	25	19	26	19	26	19	26	19	26	19	25
20	26	20	27	20	27	20	27	20	27	20	26
21	27	21	28	21	28	21	28	21	28	21	27
22	28	22	29	22	29	22	29	22	29	22	28
23	29	23	30	23	30	23	30	23	30	23	29
24	30	24	31	24	July 1	24	31	24	31	24	30
25	May 1	25	June 1	25	2	25	August 1	25	August 1	25	31
26	2	26	2	26	3	26	2	26	2	26	October 1
27	3	27	3	27	4	27	3	27	3	27	2
28	4	28	4	28	5	28	4	28	4	28	3
29	5	29	5	29	6	29	5	29	5	29	4
30	6	30	6	30	7	30	6	30	6	30	5
31	7	31	7			31	7			31	6

may take place—fætuses of different ages may be present in the same uterus. "Such" plural pregnancies are abnormal, inasmuch as the children resulting therefrom are subject to much higher rates of mortality aud disease, both mental and physical, than are children born singly; also the risk to both mother and child is greater in multiple than in single pregnancy. Twins are most frequently of opposite sexes; when of the same sex females predourinant over males. In plural births the children are smaller and feebler than those born singly. In the cases of twins, it is not unusual to find one fætus much more deve than the other; sometimes one fætus dies and is expelled, the living fætus retained to the full term, or the dead faetus may shrivel up and harden and in that state remain in the uterus until the birth of the living child. The duration of the pregnancy in twins is usually shorter than the normal period. Ordinarily the chidren are born within a short interval of each other, but occasionally the interval is prolonged over several hours, and, very exceptionally, it has been known to last weeks or even months.

HERMAPHRODITES.

These are persons in whom the external genitals are so imperfectly developed that it may be difficult to determine the sex. In them, there is an ambiguous devolopment of the reproductive organs leading to various degrees of double sex. In some, there is an ovary on one side and a testis on the other; again a pair of badly developed ovaries in one combine with a pair of badly developed testes. This deformity has to be assigned to conception having taken place at the junction of the bright and dark fortnights, i-e., on full moon and new moon nights.

CHAPTER VIII..

CHECKS TO PROCREATION.

Umprejudieced observation of facts will show that it is neither an impossibility nor something unreasonable to demand greater continence. The greater continence the better; it is better than less continence, while absolute continence is still better than great continence. Absolute continence is not a state wholly dissimilar in nature from incontinence; it is only the one extreme of a process which has its complemantary extreme inself-indugence. Judicial devolopment of will power and physical endurance will infallibly have the desired effect. Perseverance alone is needed to attain ultimately the desired end.

The means to be employed to attain such a happy result differ in each individual case. Physical or mechanical means of stopping the flow of semon are undesirable, because both useless and injurious The mind must control the body wholly, not only in this function of life, but in all others. Stoic self-discipline will bring success in this as in all other stugles for self-mastery. Hygienic rules and common-sense application of them will be invaluable, and to every one who seeks the road with all his heart all necessary guidance will be granted by the Divine within.

Separate beds for husband and wife will in a great measure help to prevent sexual excesses. For the close bodily contact under a common bed-clothing is a constant provacotion to amorous ideas and sensations. One should observe perfect chastity, by which is meant not only singlehearted devotion to one's wife or husband, but moderation in amative indulgence in married life.

The use of X-rays and mellowa oil are the surest chceks to impregnation. In men, the mere presence of an X-ray atmosphere incidental to radio-graphy, sooner or later, causes a condition of complete sterility.

A fine of fine dry sponge should be oiled in clean water for about half an hour just to remove any contagious matter that may remain in it, and then exposed to the sun and air to dry. About 90 drops of refined mellowa oil should be poured upon a plate and the sponge rolled over the oil to become coated with it. Just after connection, the sponge may be slipped up the passage in the female to the uterus and allowed to remain there for half an hour, and then taken out and removed the following morning. No inconvenience or injury will result thereby. The sponge absorbs all the male elements that remain and arrests, by the efficacy of the oil, the movement of the spermatozoa precluding the possibility of impregnation. A surgical method is also resorted to in which the vas deferens on each side is exposed through a slit in the scrotum, then tied in two places with silk and severed between the ligatures. The use of chemical powders † for disinfecting the vaginal tract, so for as speremalozoa are concerned, are harmful and might lead to serious results.

CHAPTER IX.

INTOXICANTS.

The term is poplarly restincted to the temporary effect of overdoses of alcohol. After temporary stimulation and exitement the powers of volition and percepton are blunted, so that intoxication may advance from unusual liveliness in movement, speach and thought to a comatose condition, in whicn consciousness is last and the intoxicated person lies like a log, with respiration and circulation so depressed as to endanger life. The more diffusible the stimulant, the more quickly does it act. It ensues more easily when alcohol is introduced into an empty stomach. The symptoms are essentially due to the action of alcohol upon the nervous system, and they vary with the individual, with the form of the alcohol, and with the quantity taken. Since alcohol acts more readily upon the cerebrum, the nervous centres are the first to be affected. The symptoms are caused partly by dilatation of the cerebral blood-vessels, and partly by the direct effect of alcohol on the brain cells. The preliminary exaltation is chiefly due to the increased blood supply of the brain, while the graver degrees of intoxication may be referred to the toxic action of alcohol on the nerve cells. The habit engendered in those resorting too much to intoxicating liquors is leads to loss of self-respect and shame, neglect of family and duties to children, waste of money and property and lastly, amenability to bad association and finding one self located in undesirable places.

COFFEE.

It is a stimulant to the heart and nervous centres. It increases the activity of the skin and kidneys, and in some persons acts as a mild apericent. It takes away the sence of fatigue, and when mixed with milk and sugar is nutritive as well as stimulating like cocoa. In exces itacts as a poison, producing toxic symptoms such as tremor of the muscless, nervous dread, and patpilation. It is an antidote to poisoning by opium and alcohol.

CHAPTER X.

EXERCISES.

Exercise is the putting of our body in motion. It is divided into two classes ***physical & mental. Physical*** training has for its object the developing and training the body by means of systematic physical exercises. Governes, gymnastics and swimming are the principal exercises depended upon.

The more we exert ourselves the stronger we become. It is necessary to health. The body is lik a machine, and can only be kept in a good working condition by proper attention to the laws of health. Want of exercise causes weakness of body and mind. On the other hand moderate exercise invigorates the body and should be taken regularly. It is of many kinds, and should be varied so as to bring all the muscles into play. Walking is a good exercise but the best of all is swimming. The games are cricket, football, tennis, croquet, rowing, riding, racing, gymnastics and drill, all of them excellent. Besides these such amusements as reading, singing, chess, &c, are useful in their own way. Excessive exercise is should be avoided. That exercise is most beneficial which animates the mind, cheers the spririts, and invigorates the body. It is no waste of time to engage in sports all work and no play is sure to bring on weariness and sickness.

There is yet another aspect in which exercise should be viewed. From the earliest periods, man's life has been divided to seven periods or stages, through which he has to pass :—1. the infant (within seven years); 2. The boy (until the age of discretion at twice seven years); 3. the youth (until the growth of beard at thrice seven years); 4. the young man (up to four times seven years i. e, until the whole body is grown); 5 the man (up to seven times seven years); 6. the elder man (up to eight times seven years); 7. the aged man (whatever is beyond the age of fifty-six). These periods are really so many different epochs in man's life, during which the pleasures, toils, diseases, pursuits, &c, are as different and as peculiar as are the habits of one animal from another. Man arrives at his prime at four times seven, years and thus he continues until seven times seven when he may be said to have ceased to build up the fabric ; and age now gradually takes down what adolescence had previously raised.

It is said that perpetual motion and change is the grand law, to which the whole of the created universe is subject, and that minut able stability is no where to be found but in the eternal mind that rules and governs all things.

One of the most beautiful evidences of the-all-creating power and wisdom of god is to be met with in the well-known fact that the growth of man harmonizes with his wants. The sucking babe unprovided with teeth required for mastication, gets its necessary elements of nutrition in the maternal milk, and thus one might go on tracing the perfect adaptation of internal structures to the requirements of man in the several stages of life. This beautiful harmony is well-nigh tfraceable in the vegetable kingdom also. These facts establish that the law of periodicity or cycle is the basis of Nature's grand operatins. As these stages pass on from one to another, from life to death, highly important changes take place in the human frame. It may be further noticed that each stage brings with it so many special desiases, each peculiar to the period of life. Similarly, each stage of life requires particular exercises.

The first stage, as every other, requires purer air and cleanliness of skin. The second the most perilous, stage requires presh air. whole-some food, and clearly body. during the third stage, much attention has to be given to the diet, change of air and cleanliness. In the last two cases, the cultivation of corporeal powers, by running, climbing, tumbling, swimming and exposure to all kinds of weather will give the body the utmost possible agility and readiness. During the fourth stage men and women are specially susceptible to disordered stomach and deranged nervous system, when the skin ought to be forced to carry off a large quantity of moisture by the persons being active in their employments. Cheerful society, intellectual employment with open-air exercise, especially equestrian, will maintain a healthy tone of mind and body during the fifth stage. The sixth stage is the claimateric period of life when degeneration in sensibly comes on, and fat now takes the place of muscles, glands and even bones. The brittleness of bone in old persons, and their readiness to become fractured are characterestic, but this may be obirated by much out door exercise such as walking non-violen and non-exhausting, and riding, the most useful one to persons in advanced life.

CHAPTER XI

INFANTS.

No moman has the smallest ground for refusing to suckle her offspring, and to give it that inastinable boon which God has furnished her with, for the sustenance, comfort and growth of her helpless babe, namely, the maternal milk. Necessity alone can plead as an excuse, such as inflamed breasts a or deficiency of milk from debility or constitutional causes, so that nursing would endanger the life of the parent. A mother is no more justified in entrusting the care of her babe to a wet-nurse than she is in denying herself her own daily sustenance. It is in the highest degree a moral obligation on her part, to give her offspring the parental milk, for the first 9 months at least. An infant generally begins to feed from the breast within twenty-four hours after birth. The flow of milk is not usually established until the third day after labour; but because of the beneficial effect in stimulating the secretion and in contracting the uterus, the child should be pu to the breast several times in the first twenty-four hours. But continuous application to an empty breast is to be avoided. Should the child be very hungry, a few teaspoonfuls of warm milk mixed with a like quantity of water may be given.

When the milk flows freely, the child should, for the first two months, be put to the breast every two hours during the day, and every four hours during the night. The test of proper feeding is a steady increase of weight from the end of the first week onwards. In the first two or three days the child usually loses a few ounces, but soon regains them From five to seven ounces is a fair weekly gain. This rate of progress should be maintained for about five months, and at the end of a year a healthy child weights about three as much as at birth. A child is usually good tempered if his food be suitable in a grandity and quality. Habitual fretfulness is often due to mal—nutrition. Should the milk be at fault, as it may from ill health on the mother's part, either a wet-nurse or another substitute for the maternal milk should be employed. Generally the best substitute is good cow's milk, diluted with water, and slightly sweetened. Owing to the great risks of tuberculous infection from milk, it is advisable always to scald the milk before use. At first the milk and water should be in equal quantities, and each month the proportion of water should be gradually lessened, until pure milk is given many children digest better if the dilvent be not plain, but lime or barely water, both of which prevent the formation of large curds in the stomach. The bottle used must be of the simplest pattern ; it should have no angles and no tube, but at one end it ought to have a nipple fixed directly to the bottle. If the mother become pregnant she must stop nursing. That a nursing woman does not become pregnant is a common but erroneous belife.

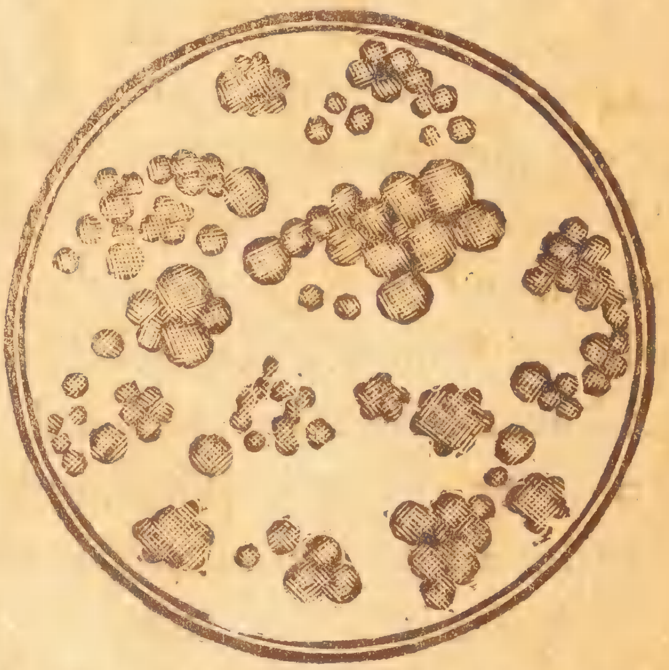
The best time to give the infant suck is about the fourth hour after meals, when the milk contains more nourishing materials. as the digestion is then nearly completed.

If the mother go 8 or 10 hours without food, the milk becomes yello wish and even nanseous, and is often spit out by the infant.

About the fourteenth week, the rash of "red gun" usually appears, caused by "breeding the teeth." The structure of these rudinentary masticators, buried in the infautile jaws, their evolution at distinct and marked periods. their symmetrical arrangement in pairs, the growth of the teeth themselves, their changes to maturity, and then decay in the first set and their replacement by another, present a train of mysterious, yet wonderful operations in which the mind is lost in contemplation The "breeding" time may be known by the looseness with which the infant grasps the nipple, and the prequency with which it lets go its hold, accompanied with fretfulness, and succeeded by copius discharge of clear water (saliva) from its mouth. The excited irritability of the gums is deadened by biting any hard substance. It is important at this period that the maternal Milk should be free from acidity; for an excess of vegetable food or an indulgence in potatoes, wine, or sprits, will tend to irritate the infant's stomach, by an increase of acid in the milk, and thus the nervous excitement may run on to the production of startings in sleep, dry cough, relaxed bowels, and even convulsions and death. The weaning time at length arrives, and with it, perhaps three or more pair of teeth. This is the period of the greatest importance to the health of the infant. It is no exaggeration to state that amongst the children of the humbler classes a very high percentage die under two years of age, from ill feeding or over feeding, rather than from want of food. It may be observed that those children who are over-fed with with starchy &c, substances, though they plump up, yet they are oftener the victims of croup than the more delicate, puny ones, who refuse much of the food which the others eat with avidity.

After the nineth month, a small quantity of wheat flour may be added to the mother's milk to serve as food for the infant, as the nutritions wheat lour is a powerful flesh former. This important agent serves to build up the infantile brain and nerves, or to repair the constant loss of this matter during our manhood growth.

Health woman Milk.



Unhealth woman Milk.

The whole process of dentition is so intimately convected with the healthy growth of the child and it would be well if mothers made themselves throughly conversant with the operations of Nature and narrowly watched this process from month to mouth. Convulsions, tardiness of speech, stuffering, which may merge into confirmed stammering, periodical headaches, imperfect digestion, wasting, and capricious bowels, are a few of the disorders arising from imperfect dentition.

The great amount of sickness prevailing among children may be averted by freshness of air, wholesomeness of food, and cleanliness of body. A deprivation of the first leads to lung diseases, the absence of the second swells the number of deaths render convulsions while, a want of cleanliness in person, in clothing and in the home, help forward other calamitics in a woeful degree, of which bowel disorders, especially infantile cholera, are the most formidable. In cases of feeble digestion, with a pale skin and imperfectly nourished limbs, it is very desirable to accustom the child to cold seabathing, or some artificial substitute of that kind.

Dandriff in children, is the plague of nursery, the opprobrium of mothers, and the enemy of soap and water. Frequent and regular ablution of the forehead, where first appears, rubbing the head dry, and applying some specific lotion, is desirables. The use of oil, grease, &c, is often prejudical than useful ; for, in many cases of dentition, the secretion of greasy matter about the head and face is abundant. The increase of saliva, also, at this period, is very marked ; so that not only do infants slobber very much defore bentition, but the suck-thumb habit appears toowe its origin to the relief which a constant flow of saliva affords to the turgid gums. Observing mothers will notice that the cutting of every tooth is preceded by a regular sneexing and cold in the head, and that the bowels during this period are torpid, and the infant feverish and out of sorts. Whenever this state of things comes on , the diet of the child should be exclusively attended to.

END.

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